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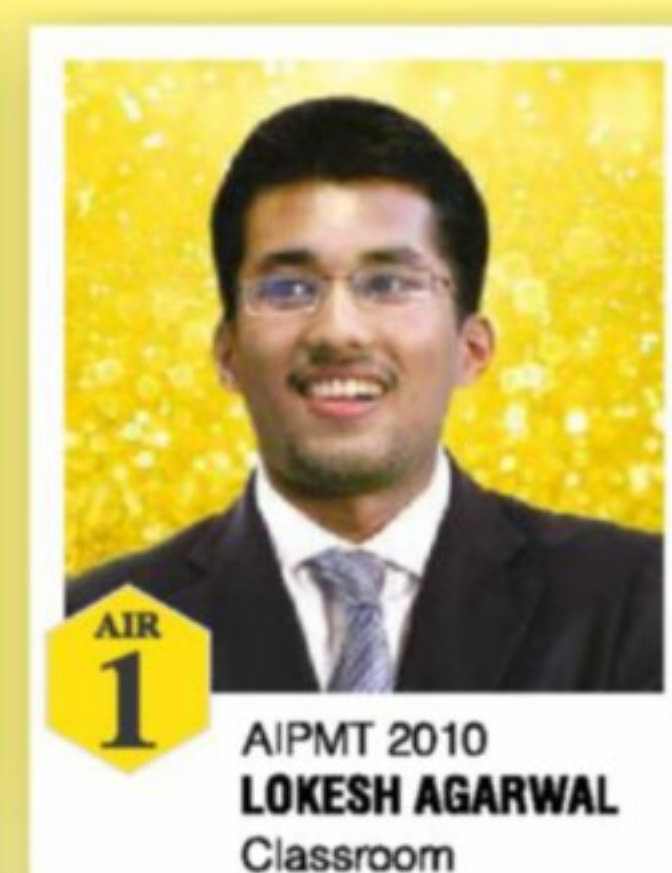
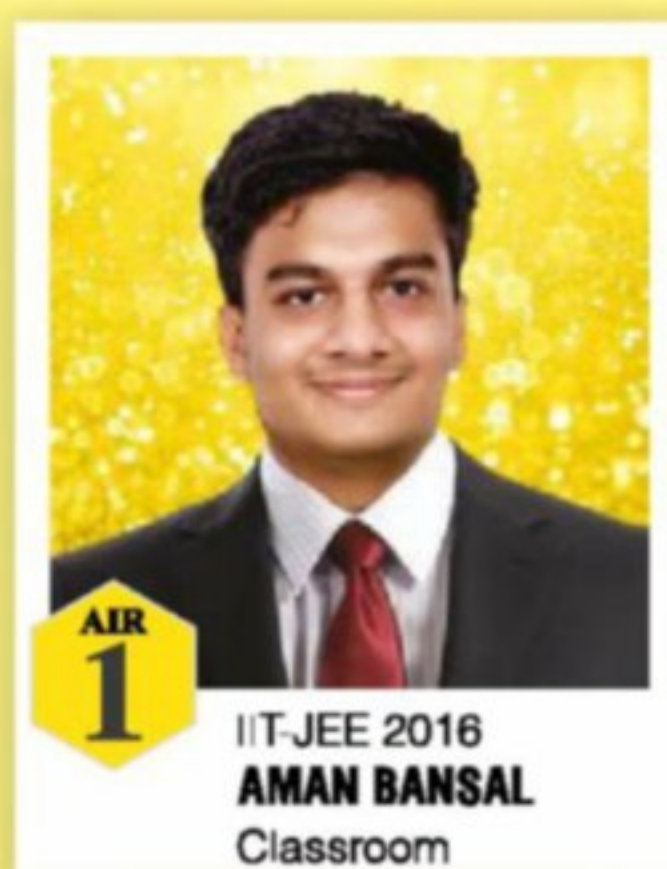
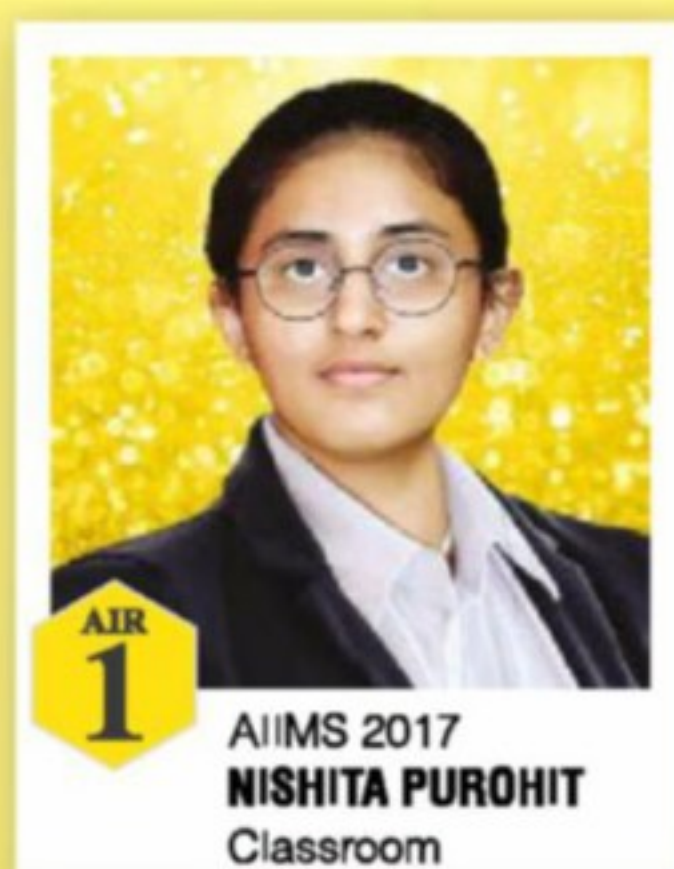
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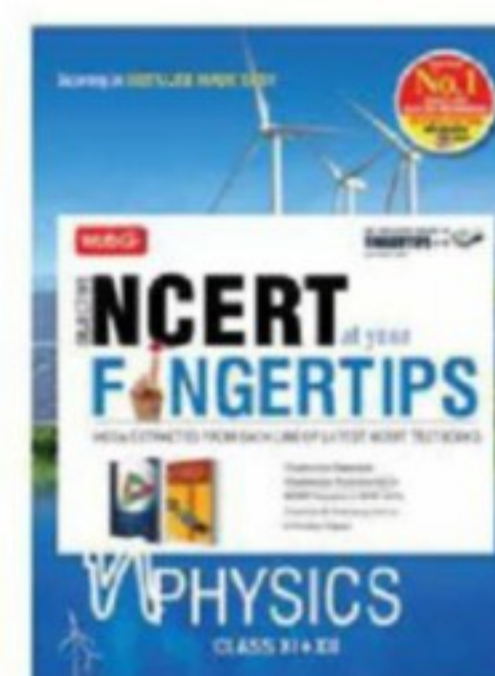
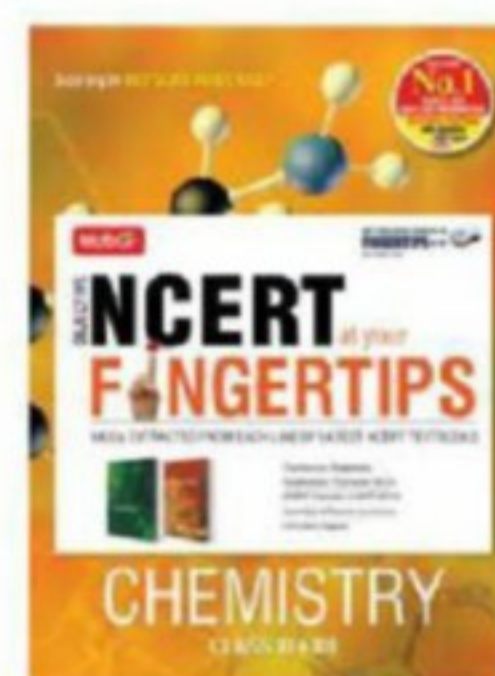
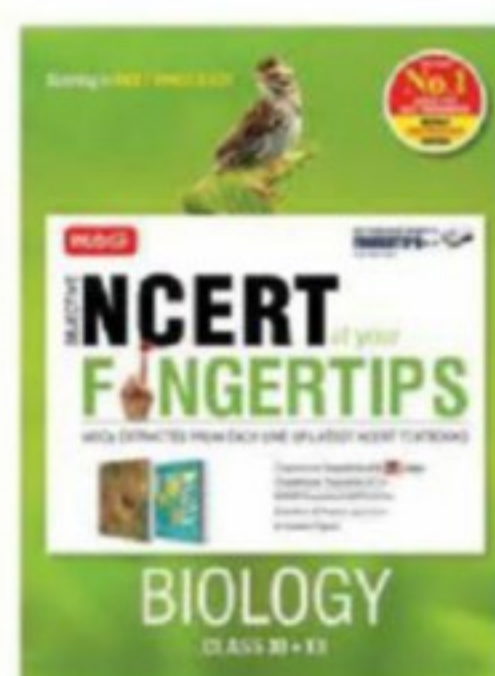
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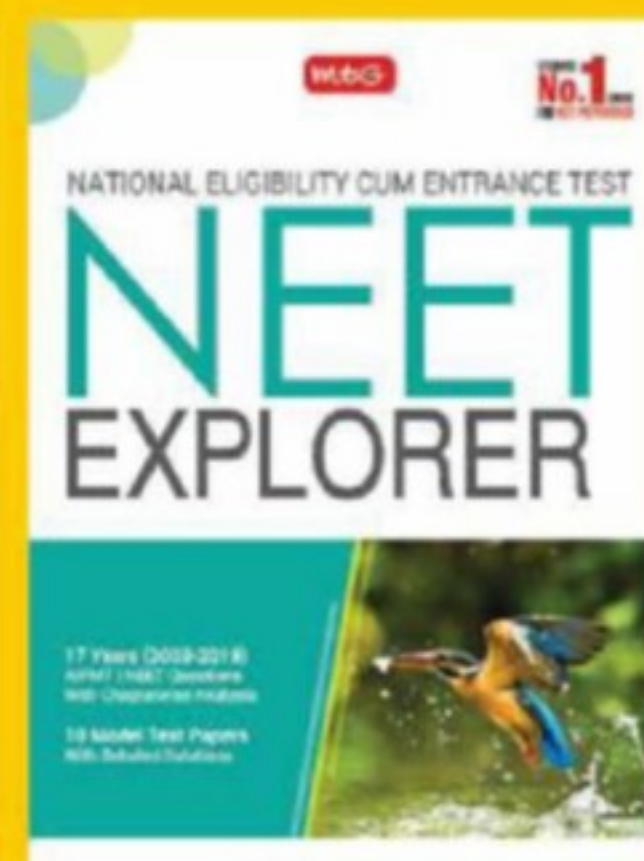
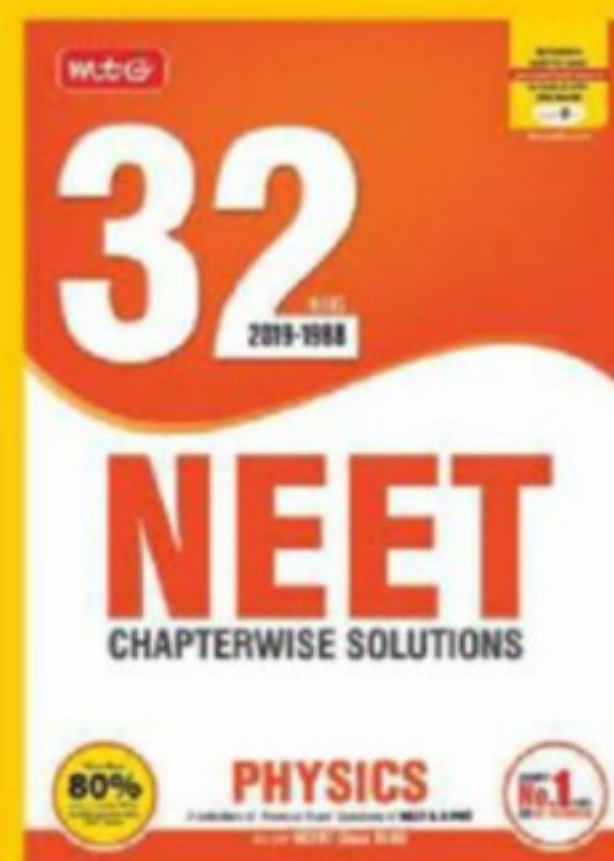
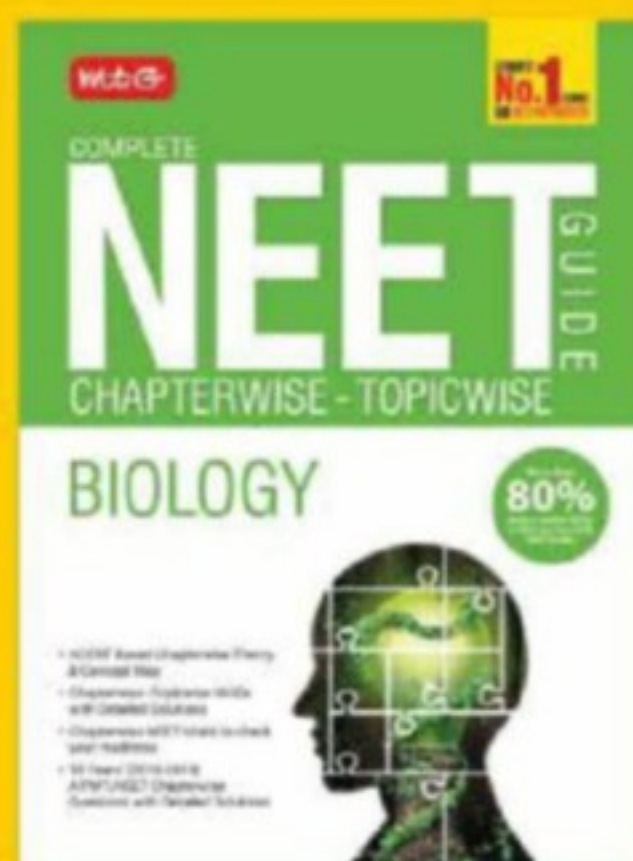
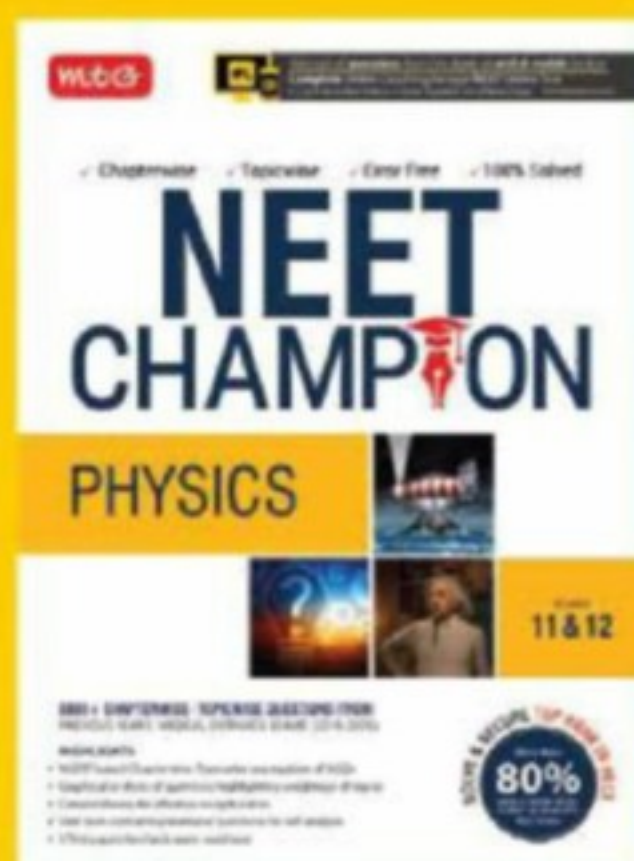
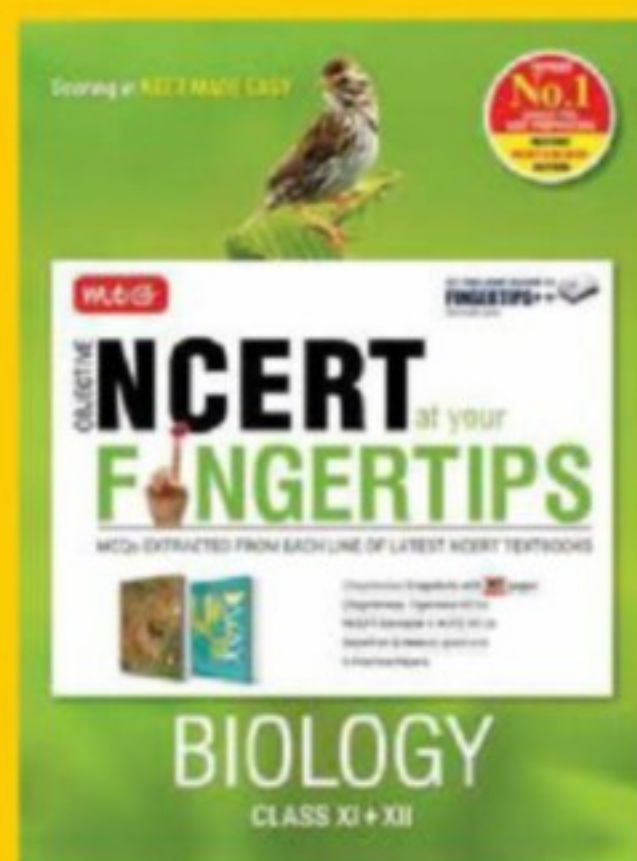
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Plot 99, Sector 44 Institutional Area,
Gurugram -122 003 (HR), Tel : 0124-6601200
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Regd. Office:

406, Taj Apartment, Near Safdarjung Hospital,
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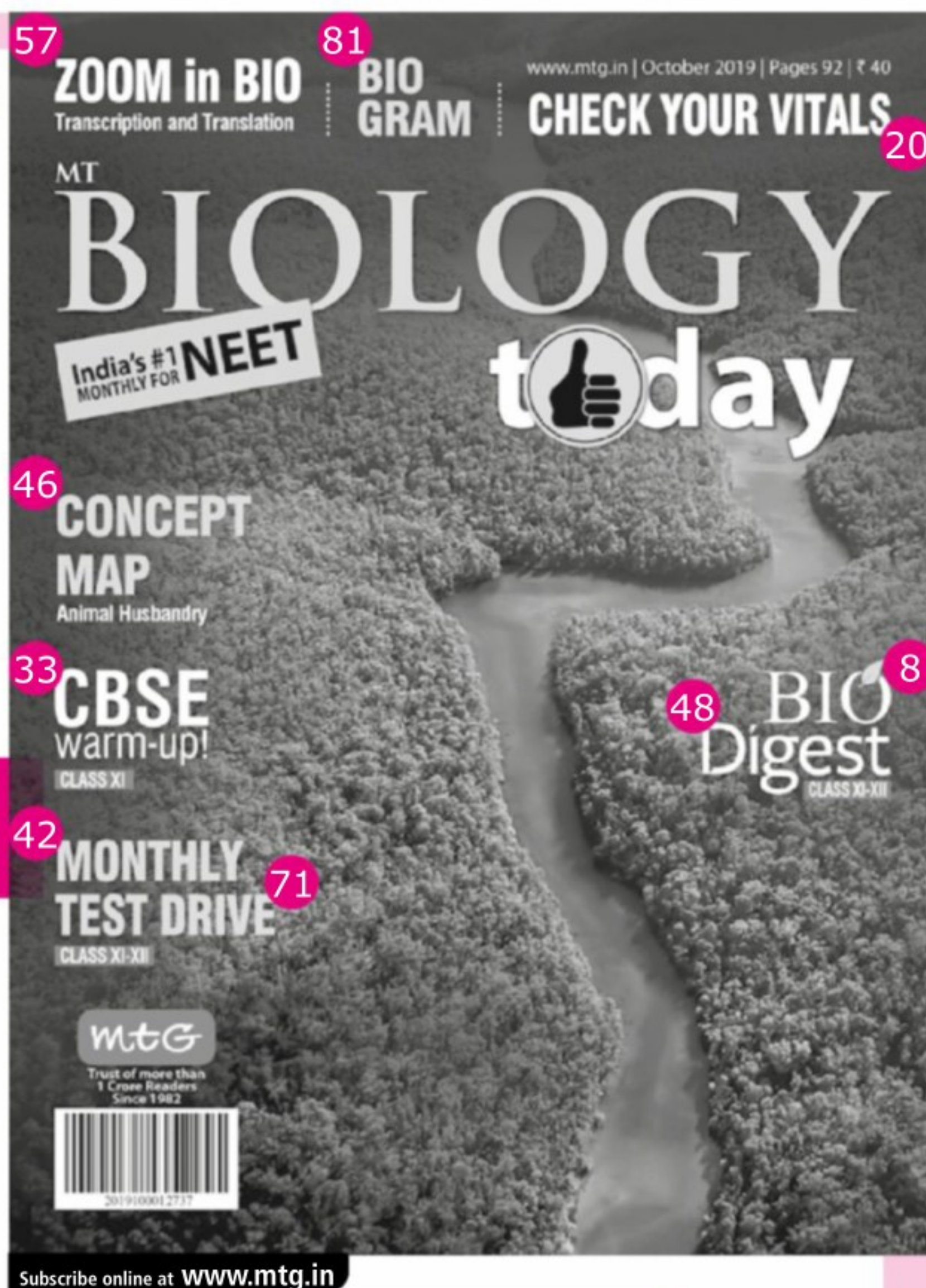
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BIO Digest

This article covers high yield facts of the given topic.

Transport in Plants

- Plants do not have a regular circulatory system but they need to move or **transport** various types of substances over **short** (*i.e.*, within the cell, across the membrane and cell to cell) or **long distances** (*i.e.*, from root to leaves). The long distance transport that occurs through vascular tissues, *i.e.*, xylem and phloem is called **translocation**. It occurs through mass flow.

MEANS OF TRANSPORT

- Passage of materials into and out of the cells, *i.e.*, short distance transport is carried out by a number of methods—**diffusion, facilitated diffusion and active transport**.
- Diffusion** is the movement of materials along the concentration gradient, *i.e.*, from region of higher concentration to the region of lower concentration. It is slow and passive, *i.e.*, no energy expenditure takes place. Diffusion is very important to plants, as it is the only means for gaseous movement within the plant body.
- Facilitated diffusion** : The passive absorption of hydrophilic substances, mediated by a **carrier**, is called **facilitated diffusion**. It takes along concentration gradient and no energy is utilised. The movement is facilitated through fixed membrane transport proteins.
- The **transport proteins** allow the passage of selected ions and other polar molecules. Transport proteins are of two types - **carrier proteins** and **channel proteins**.
 - Carrier proteins bind to the particular solute to be transported and deliver it to the other side of the membrane.
 - A molecule, when moves across the membrane through carrier protein independently of other molecule, the process is called **uniport**. Some carrier proteins allow transport only if two types of molecules move together, this process is called **cotransport**. In cotransport, when both the molecules cross the membrane in same direction at the same time, it is called **symport** and when it is in opposite direction, the process is called **antiport**.
 - Channel proteins allow diffusion of the solutes of an appropriate size. They are of two types – **ion channels** and **porins**.
 - Ion channels allow specific ions and they are often gated—voltage gated, mechanical and ligand gated.
 - Porins** are large protein pores which allow even small sized proteins to pass through. They are present in the outer membranes of plastids, mitochondria and in some bacteria.
- Active transport** : It involves the movable carrier proteins called pumps which employ ATP energy for transport across the membrane. It is **uphill** process, *i.e.*, against the concentration gradient and is faster than passive transport.

PLANT- WATER RELATIONSHIP

- Water is essential for all physiological activities of the plants. It is often a limiting factor for plant growth and



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productivity, both in agriculture and natural ecosystems. Water absorption in plants depends on various methods and factors.

Water Potential

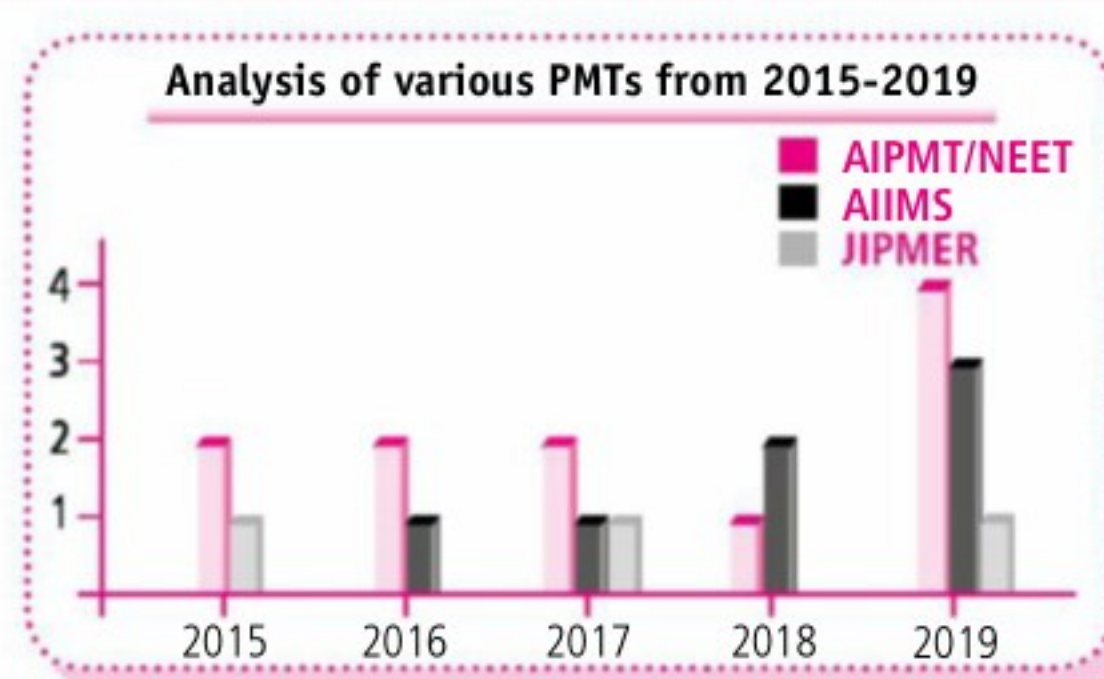
- Water potential (ψ_w) is the difference between the free energy of water molecules in pure water and the free energy of water in any other system at the same temperature and pressure, *e.g.*, water in a solution or in a plant cell or tissue. At atmospheric pressure, **pure water** has **zero water potential**, however, in solution the value of water potential is always negative or less than zero as the presence of solute reduces the free energy of water and thus decreases the water potential (negative value). Water always moves from the area of high water potential or high free energy to the area of low water potential or low free energy. Water potential in a plant cell or tissue can be written as $\psi_w = \psi_m + \psi_s + \psi_p$ where, ψ_w = Water potential, ψ_m = Matric potential, ψ_s = Solute potential and ψ_p = Pressure potential
- **Matric potential** (ψ_m) is influenced by the presence of matrix. It is not significant in plant water relationship so often disregarded, simplifying equation as $\psi_w = \psi_s + \psi_p$.
- **Solute potential (osmotic potential)** (ψ_s) is the amount by which the water potential is reduced as a result of the presence of solute. It always has negative value. The more the solute molecules, the lower is ψ_w .
- **Hydrostatic pressure (pressure potential)** (ψ_p) is the pressure which develops in an osmotic system due to osmotic entry or exit of water from it. A positive pressure develops in a plant cell or system due to entry of water into it, which is called **turgor pressure (TP)**. Loss of water produces a negative hydrostatic pressure or **tension**. Due to turgor pressure, the protoplast of a plant cell will press the cell wall to the outside. The cell wall, being elastic, presses the protoplast with an equal and opposite force. This force exerted by the cell wall over the protoplast is called **wall pressure (WP)**.
- Normally the wall pressure is equal and opposite to turgor pressure except, when the cell becomes flaccid.
- Turgor pressure keeps the cell and cell organelles stretched. It provides support to non-woody tissues like parenchyma. It is also essential for cell enlargement during growth. Turgor pressure is also linked with stomatal conductance and many plant movements.

Osmosis

- Osmosis is a process by which molecules of a solvent pass through a semipermeable membrane from a region of higher concentration to the region of lower concentration. The osmotic entry of water into a cell is termed as **endosmosis** whereas the osmotic withdrawal of water from a cell is called as **exosmosis**.
- **Osmotic pressure (OP)** is the pressure which needs to be applied to a solution to prevent the inward flow of water across a semipermeable membrane. Osmotic pressure is

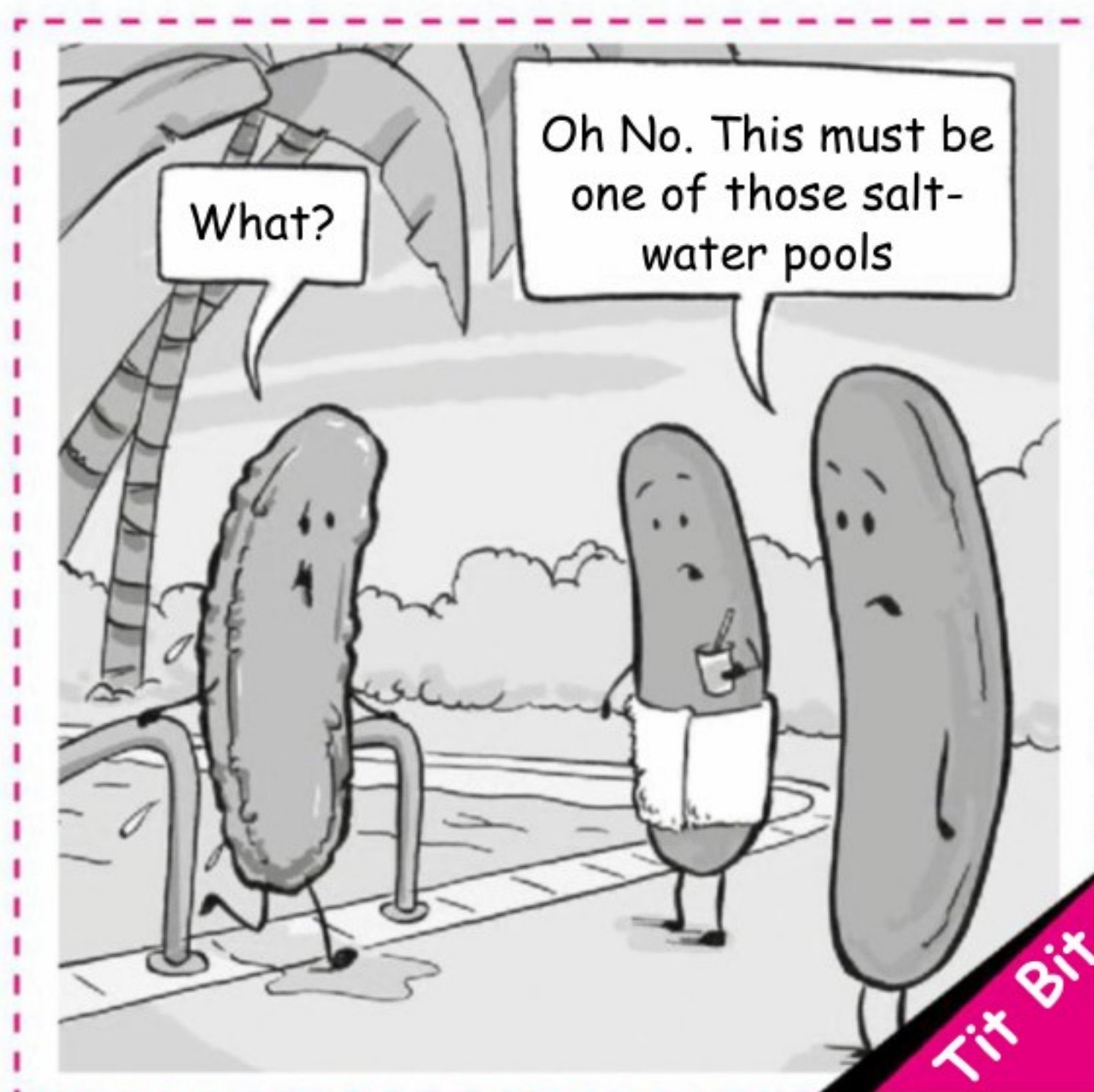
numerically equal to the osmotic potential or solute potential (ψ_s), but the **osmotic potential has a negative value, while osmotic pressure has a positive value**.

- **Diffusion pressure deficit (DPD)** is the reduction in the diffusion pressure of water in a solution over its pure state. It is also known as **suction pressure**. $DPD = OP - WP (= TP)$
- The behaviour of plant cells with regard to water movement depends on the surrounding solution that may be of three types:
 - **Hypotonic solution** has lower osmotic concentration and hence lower osmotic pressure as compared to another solution.
 - **Hypertonic solution** has higher osmotic concentration and hence higher osmotic pressure as compared to another solution.
 - The two solutions with the same osmotic concentration or osmotic pressure are termed as **isotonic solutions**.



Plasmolysis

- Shrinkage of the protoplast of a cell from its cell wall under the influence of a hypertonic solution is called plasmolysis. Due to withdrawal of water from cytoplasm and central vacuole of cell, the size of protoplast reduces. The first stage of plasmolysis is called **limiting plasmolysis**. The cell is called **flaccid**. The extra hypertonic external solution continues to withdraw water from the central



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vacuole by exosmosis. Central vacuole shrinks causing shrinkage of protoplast from cell wall and causes **incipient plasmolysis**. Due to continued exosmosis, protoplast shrinks further and withdraws from cell wall except at one or a few points, known as **evident plasmolysis**.

- The swelling up of a plasmolysed protoplast under the influence of hypotonic solution is called **deplasmolysis**. It is possible only immediately after the plasmolysis and is due to endosmosis.

Imbibition

- It is adsorption of water by the solid particles of a substance that causes the enormous increase in size and volume. The absorbents that take part in imbibition are called **imbibants**, e.g., seeds, dry wood, etc. The water which gets adsorbed in this process is called **imbibate**.
- Amount of imbibition depends upon - (i) water potential gradient between adsorbent and water and (ii) affinity of adsorbant for water.



INTEXT PRACTICE QUESTIONS

1. What is the difference between osmotic pressure and osmotic potential?
2. What is active transport and how it is different from facilitated diffusion?
3. What is imbibition? What are the factors affecting imbibition?

Absorption of Water in Plants

- Absorption of water in land plants mainly occur from soil through roots which are often extensive and grow rapidly into the soil. Plants have developed a **mass** or **bulk flow system** that operates through development of pressure difference between the source and sink.
- There are two different pathways of water passage from root hair to xylem inside the root-**apoplast** and **symplast**.
- In **apoplast pathway** water passes from root hairs to xylem through the walls of intervening cells without crossing any membrane or cytoplasm. It provides the least resistance to movement of water. It is interrupted by the presence of impermeable lignosuberin Casparian strips in the walls of endodermal cells.
- In **symplast pathway** water passes from cell to cell through their protoplasm crossing plasmalemma (cell membrane). Water does not enter cell vacuoles and moves through plasmodesmata. This type of movement is aided by cytoplasmic streaming of individual cells. It is, however slower than apoplastic movement.

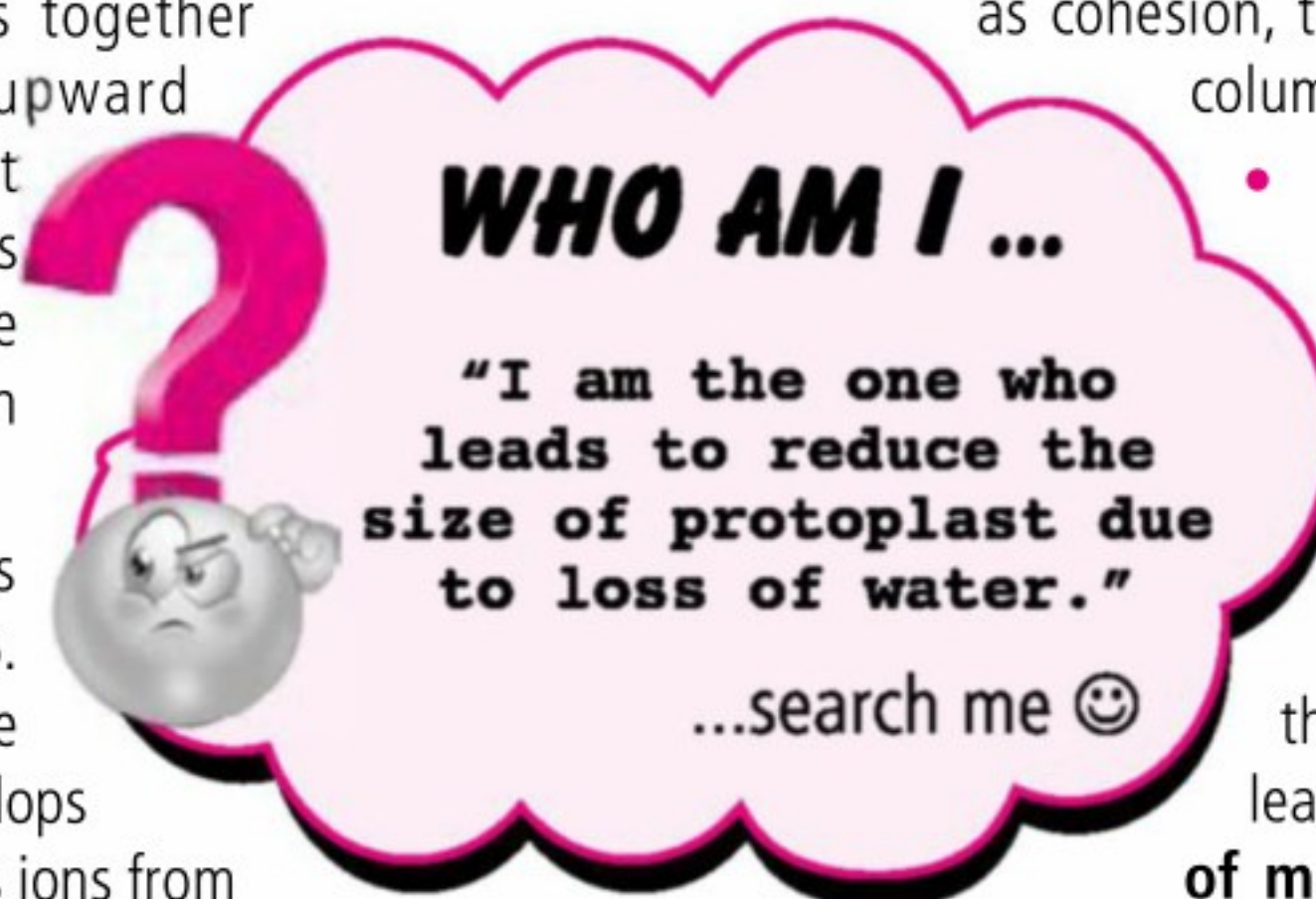
Translocation of water

- Absorbed water and minerals together constitute the **sap**. The upward movement of sap from the root towards the top of the plant is known as **ascent of sap**. There are many theories to explain ascent of sap.
- **Root pressure theory** was introduced by **Priestly** in 1916. Root pressure is a positive hydrostatic pressure which develops in the xylem sap of roots. Various ions from

the soil are actively transported into the vascular tissues of the roots, water follows and thus pressure inside the xylem is increased. Root pressure can push up water to small heights only.

- This theory got certain objections, e.g., no or little root pressure has been seen in gymnosperms. In tall trees the magnitude of pressure developed due to root pressure is too small to push the water to the apical region. Water continues to rise upward even in the absence of roots.
- The most widely accepted theory for ascent of sap is **transpiration pull theory** or **cohesion-tension theory**. It was proposed by **Dixon** and **Jolly** in 1894. According to this theory, there is a continuous column of water from root through the stem and into the leaves. Water molecules remain attached to one another by a strong mutual force of attraction called **cohesion force**. This is due to hydrogen bonds formed amongst adjacent water molecules. There is another force called **adhesion force** between the walls of tracheary elements and water molecules. It produces **surface tension** that accounts for high capillarity through tracheids and vessels. The column of water does not fall down under the impact of gravity because forces such as cohesion, tension and adhesion keep the water column in place.

- Intercellular spaces present amongst mesophyll cells of the leaves are always saturated with water vapours and connected to the outside air through stomata. Outside air has lower water potential than the moist air present inside the leaf, thus water vapours diffuse out of the leaves. As a result, the **turgor pressure of mesophyll cells decreases** and the



diffusion pressure deficit (DPD) increases. Now these cells take water from adjoining cells and the turgor pressure of those adjoining cells decreases. This process is repeated and ultimately water is absorbed from nearest xylem vessels of leaf. As there is a continuous water column inside the xylem elements, a **tension** or **transpiration pull** is transmitted down to root, **resulting in the passive upward movement of water.**

TRANSPIRATION

- Transpiration is the **process of water loss in the form of water vapour from the aerial parts of the plant.** It may be **stomatal, cuticular** and **lenticular** type. Most of the transpiration (50-97%) occurs through foliar surface, *i.e.*, stomatal transpiration.
- **Stomata** is a pore or aperture, found in epidermis of leaves, enclosed by two **guard cells** and facilitates gaseous exchange. Usually the lower surface of a dorsiventral leaf has a greater number of stomata while in a isobilateral leaf, stomata are about equal in number on both surfaces.
- **Opening and closing of stomata** are governed by change in O.P. or turgidity of guard cells. Different theories about the mechanism of stomatal movements have been proposed. **Malate** or **K⁺ ion pump hypothesis** is the most accepted one which was initially given by Fujino (1959) and later modified by Levitt (1974). Factors affecting stomatal movements are temperature, light, humidity, water availability, CO₂ concentration, pH, oxygen, growth hormones, minerals, etc., and the factors affecting transpirations are relative humidity, atmospheric temperature, light, air movements, atmospheric pressure and availability of water.
- Transpiration (i) controls the rate of absorption of water from the soil, (ii) controls the ascent of sap; (iii) responsible for cooling of leaves, hence regulates the plant temperature, (iv) protects the leaves from heat injury. It also have some adverse effects like wilting in plants, limiting photosynthesis, etc.

GUTTATION

- **Loss or excretion of water in the form of liquid droplets from the tips and margins of leaves is called guttation.** It was first studied by **Bergerstein** in 1887. All plants do not show guttation. It is restricted to about 345 genera of herbaceous and some woody plants. In general, **guttation occurs when transpiration rate is very low as compared to rate of water absorption.** Due to this, root pressure is developed and water is pushed out through specialised pores at vein endings called **hydathodes**. So, guttation is not due to activity of hydathodes but due to root pressure. Common examples are Garden Nasturtium, Oat and other cereals, Balsam, Tomato, Cucurbits, etc.

- The guttated liquid is never pure water. It contains 0.6-2.5 gm (lit) of solutes, both organic (carbohydrates, organic acids, amino acids, enzymes) and inorganic (Ca²⁺, Mg²⁺, K⁺, CO₃²⁻, SO₃²⁻, Cl⁻) types.

UPTAKE AND TRANSPORT OF MINERALS

- All minerals cannot be passively absorbed by the roots, unlike water. It is because of two factors - (i) minerals are present in the soil as charged particles or ions which cannot move across cell membranes and (ii) the concentration of minerals in the soil is usually lower than the concentration of minerals in the root. Hence, most minerals must enter the root epidermal cell through active transport.
- After the ions have reached xylem of the roots through active or passive uptake, or a combination of the two, their further transport up the stem to all parts of the plants is through the **transpiration stream**. The chief sinks for the mineral ions are the growing regions of the plants, such as the apical and lateral meristems, young leaves, developing flowers, fruits and seeds and the storage organs. Unloading of mineral ions occurs at the fine vein endings through diffusion and active uptake by these cells.

PHLOEM TRANSPORT

- In plants, food (primarily sucrose) is transported by the vascular tissue phloem from the source to a sink. Transport of organic solutes from one part of the plant to the other through phloem sieve tubes is called **translocation**.
- Food is mostly synthesised in the leaves and also in young stems. The leaves therefore serve as the '**source**'. The synthesised food is translocated to the growing regions and also to the storage organs of the plant. So, these regions serve as '**sink**'. But, the source and sink may be reversed depending on the season or the plant's needs. Since the source-sink relationship is variable, the direction of movement in the phloem can be upwards or downwards, *i.e.*, **bidirectional**. This contrasts with that of the xylem where the movement is always **unidirectional**, *i.e.*, upwards.
- The most accepted mechanism for the translocation of sugars from source to sink is called the **pressure flow hypothesis** given by **Munch** (1930). As glucose is prepared at the source *i.e.*, in leaves (by photosynthesis), it is converted to sucrose (a disaccharide).
- The sucrose is then moved into companion cells and then into the sieve tube cells by active transport.
- This process of loading at the source produces a hypertonic condition in the phloem. Water in the adjacent xylem moves into the phloem by osmosis. As osmotic pressure builds up, the phloem sap moves to areas of lower pressure.

- At the sink, osmotic pressure is kept low by converting soluble organic substances into insoluble form. Again active transport is necessary to move the sucrose out of the phloem sap and into the cells which will use the sucrose converting it into energy, starch or cellulose.
- As sugars are removed from the sieve tubes, the osmotic pressure of the phloem decreases and water moves out of the phloem.



INTEXT PRACTICE QUESTIONS

4. Name the most accepted theory behind the process of stomatal opening and closing.
5. Define the force employed in transpiration pull theory of ascent of sap.

Mineral Nutrition

- Any substance (simple or complex organic molecule, or a mineral ion) that is required for the nourishment of an organism, providing a source of energy or structural components, is known as **nutrient**.
- **Nutrition** is the sum total of processes by which a living organism obtains raw materials for building of body and maintaining its body functions. Mineral nutrition in plants is the study of source, mode of absorption, distribution and metabolism of various inorganic substances or minerals by plants for their growth, development, structure, physiology and reproduction.

ESSENTIAL MINERAL ELEMENTS

- Chemical analysis of plants reveals that it comprises of about 60 different elements but all of these elements are not required for the growth of plants.
- An **essential element** is defined as the one that plays a significant structural or physiological role and in absence of which plants cannot complete their life cycle. 17 elements are found to be essential in plants. These are C, H, O, N, P, K, S, Mg, Ca, Fe, B, Mn, Zn, Cu, Mo, Cl and Ni.
- **Non-essential elements** are not required by plants and their absence does not produce any major deficiency symptoms. However, some of these have been found to be required in metabolic activities of certain plants, *e.g.*, cobalt, silicon, sodium, etc.

Classification of Essential Elements

- Essential elements are divided into two classes on the basis of the source from which they are derived and the amount required by plants.

- Minerals get depleted in the soil due to overcropping, use of high yielding varieties, non-rotation of crops, leaching or washing down of minerals and precipitation of minerals due to change in soil pH.
- The most common mineral elements which become deficient in agricultural soil are nitrogen, phosphorus and potassium (NPK), called **critical elements**.
- Majority of the fertilisers, contain all three critical elements and such fertilisers are called **complete fertilisers**.
- Deficient microelements and costlier macronutrients are sprayed over plants. The practice is called **foliar nutrition** or **foliar fertilisers**.

Based on source from which they are derived :

(i) Mineral elements

- Elements derived from soil, *e.g.*, P, K, S, Mg, Ca, Fe, Zn, Mn, B, Cu, Mo, Cl and N.

(ii) Non-mineral elements

- Derived from air or water *e.g.*, C, H and O.
- They are building blocks of macromolecules that form bulk of plant body.
- Though nitrogen (N) is abundantly present in atmosphere but plants obtain it from soil as nitrate or ammonium ion.

Based on the amount required by plants:

(i) Macroelements

- These are essential elements present in plants in easily detectable quantities, *i.e.*, **1-10 mg/gm of dry matter**.
- These are usually involved in the synthesis of organic molecules and development of osmotic potential.
- There are nine macroelements –C, H, O, N, P, K, S, Mg and Ca.
- They do not become toxic when present in slight excess.

(ii) Microelements

- Essential elements required by plants in small amounts, *i.e.*, **less than 1.0 mg/gm of dry matter**.
- They are mostly involved in the functioning of enzymes, as cofactors or metal activators.
- There are eight microelements, *e.g.*, Fe, Zn, Mn, B, Cu, Mo, Cl and Ni.
- They are toxic when present even in slight excess.

METHODS OF STUDYING PLANT NUTRITION

- Mineral requirements of plants is determined by solution culture experiment first developed by botanist **Julius von Sachs** (1860).
- Solution culture is a technique in which plants are grown from seeds to maturity in a defined nutrient solution in complete absence of soil. Growing plants in this way is referred to as **hydroponics** or **soil-less culture**.
- The solution containing various mineral elements is prepared. A normal or balanced solution for culture experiments is one having all essential elements in proper proportion, called **nutrient solution**.
- The element for which deficiency symptoms are to be studied is made deficient in the solution. To study the effect of microelements, organs of plants containing reserve food are removed.
- Culture experiment ascertains the essentiality of nutrients, role of essential element in plant's physiology, deficiency symptoms, their toxicity and the role of non essential but functional elements.
- Hydroponics is used nowadays in the commercial production of many greenhouse crops but cost of setting up a hydroponic system is very high. Different types of hydroponics system includes deep water culture, nutrient film system and aeroponics.
- **Deep water culture** : The roots are suspended in nutrient solution and aquarium air pump is used to oxygenate the nutrient solution. Light is prevented from penetrating this system as this can cause algae to grow.
- **Nutrient film system** : The plants are grown in a tube having a thin film of recirculated nutrient solution. This solution is on a slight tilt so that it flows with the force of gravity. This system not only provides good aeration to the roots and nutrient uptake but also allows the pH and nutrient, to be adjusted and monitored.

- **Aeroponics** : Roots are suspended in the air over the nutrient solution which is whipped into a nutrient mist by a motor driven rotor. High level of oxygen available at the roots promotes the growth of microbes that digest the nutrients and makes them easily available to the plants.
- Hydroponics helps in obtaining consistently better yield, control soil borne pathogens and avoid problems of weeding, conserve water and to regulate pH optimum for a particular crop.

NUTRIENT DEFICIENCY SYMPTOMS

- Deficiency symptoms are externally visible pathological conditions (morphological and physiological deformities), produced due to absence or deficiency of some essential nutritive substances. Hence, they are also called as **hunger signs**.
- Deficiency symptoms appear when the availability of essential nutrients fall below **critical concentration** (limited concentration of essential element below which growth of plant is reduced). Some common deficiency symptoms of plants are **molting** (Patches of green and non-green area), **stunted growth**, **necrosis** (death of tissue), **wilting** (loss of turgor), **abscission**, **whiptail disease** of leaves, **die back**, **chlorosis** (loss of chlorophyll), etc.

Toxicity of Micronutrients

- Toxic concentration is the concentration of nutrient in tissues which reduces its dry weight by 10%. Critical toxic concentration is different for different micronutrients as well as different plants.
- The toxic effects may be due to direct excess of micronutrient or its interference in the absorption and functioning of other nutrients. For example, manganese toxicity appears as brown spots surrounded by chlorotic veins. Mn interferes with uptake of Fe and Mg by plant that inhibits binding of Mg with specific enzymes and inhibits Ca translocation in shoot apex. Hence, excess of manganese induces deficiency of iron, magnesium and calcium.

Table: Mineral elements and their deficiency symptoms

Element	Obtained as	Constituent of	Major functions	Deficiency symptoms
I. Macroelements				
Nitrogen (N)	NO_2^- , NO_3^- or NH_4^+	Amino acids, proteins, nucleic acids, vitamins, hormones, coenzymes, ATP and chlorophyll	Involved in cell division, growth, metabolic activities and photosynthesis	Stunted growth, premature leaf fall, chlorosis appearing first in older leaves, late flowering purple colouration of stem, etc.
Phosphorus (P)	H_2PO_4^- , PO_4^{3-}	Cell membrane, nucleotides nucleoproteins, ATP, NAD^+ , NADP^+ and other coenzymes	Involved in energy transfer, cell division and phosphorylation reactions	Stunted growth, leaves appear dull green with purple and red spots, premature leaf fall, delayed flowering, etc.

Potassium (K)	K^+	Cofactor and activator of several enzymes	Associated with K^+/Na^+ pump in active transport, anion-cation balance in the cells, opening and closing of stomata, common in cell sap in plant vacuoles and helps in maintaining turgidity of cells	Yellow and shrivelled leaf margins, mottled interveinal chlorosis of leaves, loss of cambial activity, die back, etc.
Calcium (Ca)	Ca^{2+}	Present as calcium pectate in the middle lamella of cell wall, enzyme activator chromosome formation, etc.	Needed for normal cell wall development, required for cell division, cell enlargement. Selective permeability of cell membrane	Chlorosis, necrosis and curling of young leaves. Die-back of shoots due to death of apical buds, poor root growth, leaf tips become hooked, blossom end rot of tomato.
Magnesium (Mg)	Mg^{2+}	Forms a part of chlorophyll activator of enzymes involved in DNA and RNA synthesis, fat and carbohydrate metabolism and binding of ribosomes	Formation of chlorophylls, carotenoids and nucleic acid and nodule formation in legumes	Premature leaf abscission, interveinal chlorosis especially of older leaves, necrosis, marginal curling, etc.
Sulphur (S)	SO_4^{2-}	Amino acids, cysteine and methionine, vitamins, CoA, lipoic acid and ferredoxin	Involved in chlorophyll formation, growth metabolism and nodule formation in legumes	Chlorosis appearing first in young leaves reduced nodulation in legumes and less juice content in <i>Citrus</i> , etc.
II. Microelements				
Iron (Fe)	Fe^{3+}, Fe^{2+}	Component of cytochromes, ferredoxin, activator of nitrogenase, catalase and other enzymes	Involved in electron transport in photosynthesis and respiration, protein synthesis, development of chlorophyll and other pigments	Interveinal chlorosis, particularly in young leaves. May be localised to single leaf or branch due to limited mobility, necrosis later on
Manganese (Mn)	Mn^{2+}	Part of oxygen evolving complex	Metabolism and photolytic evolution of oxygen. Activator of enzymes of respiration, photosynthesis and nitrogen metabolism	Leaf - flecking or greyspots due to chlorosis and necrosis in interveinal zones. Grey speck of oat, marsh spot disease of pea, etc.
Molybdenum (Mo)	MoO_4^{2-}	Forms part of nitrogenase, nitrate reductase and activator of dehydrogenase	Takes part in nitrogen metabolism (nitrogen fixation), ascorbic acid synthesis and oxidation reduction reaction	Fall in the ascorbic acid content of the plant, mottling and necrosis in leaves, may lead to abscission of flowers, whiptail disease and loosening of inflorescence in cauliflower
Boron (B)	BO_3^- or $B_4O_7^{2-}$	Required for the structural integrity of the cell wall	Increases the uptake of water and calcium, essential for meristem activity and growth of pollen tube, involved in translocation of carbohydrates	Death of stem and root apices, rosetting of leaves, reduced flower production, causes heart rot of beets, browning of cauliflower and decreased nodulation in legumes, etc.
Copper (Cu)	Cu^{2+}	Component of cytochrome oxidase enzyme and plastocyanin	Involved in electron transport in photosynthesis	Die-back of shoots, exanthema, necrosis of young leaves extending towards base along the margin, etc.
Zinc (Zn)	Zn^{2+}	Component of carbonic anhydrase, dehydrogenases and carboxylases	IAA, RNA and protein synthesis	Little leaf and mottle leaf condition, reduction in internode length, rosette type growth. Whip tip of maize, khaira disease of rice, sickle leaf of coca
Chlorine (Cl)	Cl^-	Component of oxygen evolution, complex of photosynthesis and amylase	Essential for protein synthesis, anion-cation balance in cells	Bronze colour in leaves, chlorosis, necrosis, swollen root tips, flower abscission, etc.
Nickel (Ni)	Ni^{2+}	Component of urease and hydrogenase	Metabolism of urea and ureides	Leaf tip necrosis

ABSORPTION OF MINERALS

- Plants absorb their mineral salts from the soil, through their roots.
- The most active areas of the root for mineral absorption are **zones of elongation** and **root hair**. There are two pathways of water passage from root hairs to xylem inside the root,

apoplast and symplast (*discussed in Transport in Plants*).

- Minerals are absorbed as ions and are accumulated by plants against their concentration gradient.
- The rate of mineral absorption is usually independent of its concentration in soil.

Absorption of minerals occurs in two phases

Initial phase

- Rapid uptake of ions into outer or free space of cells or apoplast comprising of intercellular spaces.
- Ions absorbed in free space are freely exchangeable.
- Passive absorption without the expenditure of energy may take place by:
 - Ionic exchange** either by contact exchange or carbonic acid exchange.
 - Donnan equilibrium** through passive accumulation of ions against electrochemical potential.

Metabolic phase

- Ions pass into inner space or **symplast** consisting of cell membranes, cytoplasm and other living structures.
- Absorption of ions into inner space requires metabolic energy.
- Movement of ions into cell is **influx** and movement of ions outside cell is **efflux**.
- Uptake of ions takes place by ionic pumps or ion-carrier complex and ions are released on inner side of membrane.

MINERAL TRANSLOCATION

- After absorption of mineral ions by epiblema cells, the mineral salts pass radially inwards into the tracheary

elements. With the transport of water the mineral salts also pass upwardly to reach the leaves and other parts.

- Minerals move laterally in the cambium and phloem.



INTEXT PRACTICE QUESTIONS

- Which two macroelements are necessary for the formation of chlorophyll and nodule in legumes?
- What are the advantages of hydroponics?
- Which micronutrient is a component of urease and hydrogenase enzymes?

NITROGEN METABOLISM

- The global nitrogen supply is generally distributed between three major pools: the atmospheric pool, the soil pool (and associated groundwater) and nitrogen contained within the biomass.
- Nitrogen is the fourth most prevalent element in living systems and forms an essential constituent of protoplasm and component of amino acids, proteins, enzymes and nucleic acids. Nitrogen is available in abundance (78% of atmosphere) but plants cannot absorb it directly. Hence, N_2 is the most critical element.
- Nitrogen compounds are obtained from reservoir pool through nitrogen fixation, which is replenished through denitrification of nitrates and release of nitrogen from decaying organic matter. The cycling pool is augmented by ammonification and nitrification.

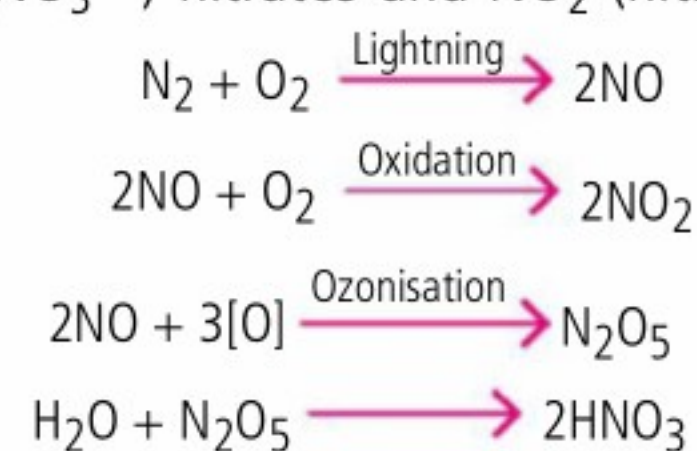
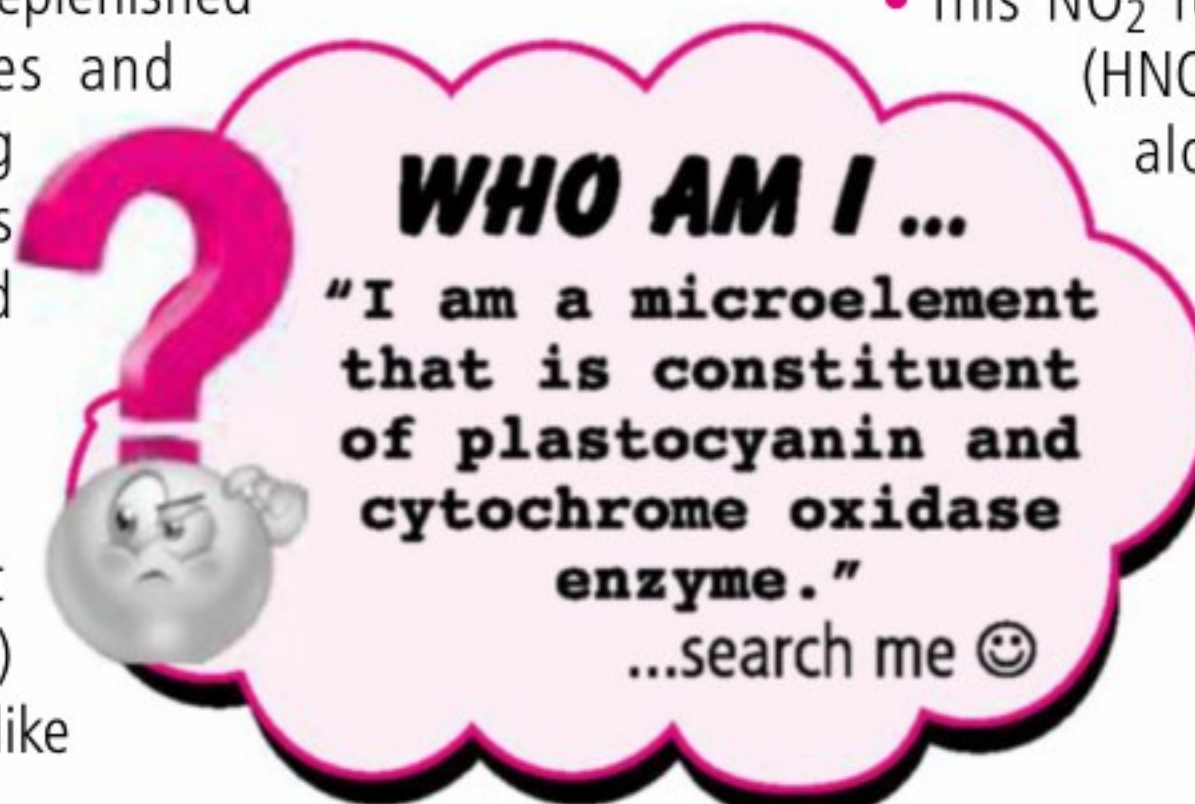
nitrate, ammonia, amino acids, etc.

- Atmospheric nitrogen can be fixed by abiological and biological methods.
- Abiological methods involve, industrial and natural nitrogen fixation.
- In industrial nitrogen fixation, nitrogen and hydrogen combines to form ammonia industrially under high temperature and pressure by using urea.
- In nature, due to lightning and thundering of clouds, N_2 and O_2 of the air react to form nitric oxide (NO). It is further oxidised to form nitrogen peroxide.

- This NO_2 reacts with H_2O to form nitrous acid (HNO_2) and nitric acid (HNO_3). HNO_3 falls along with rain water and acts with alkaline radicals to form water soluble (NO_3^{2-}) nitrates and NO_2 (nitrites).

Nitrogen Fixation

- It refers to the conversion of inert atmospheric nitrogen or dinitrogen (N_2) into utilisable compounds of nitrogen like

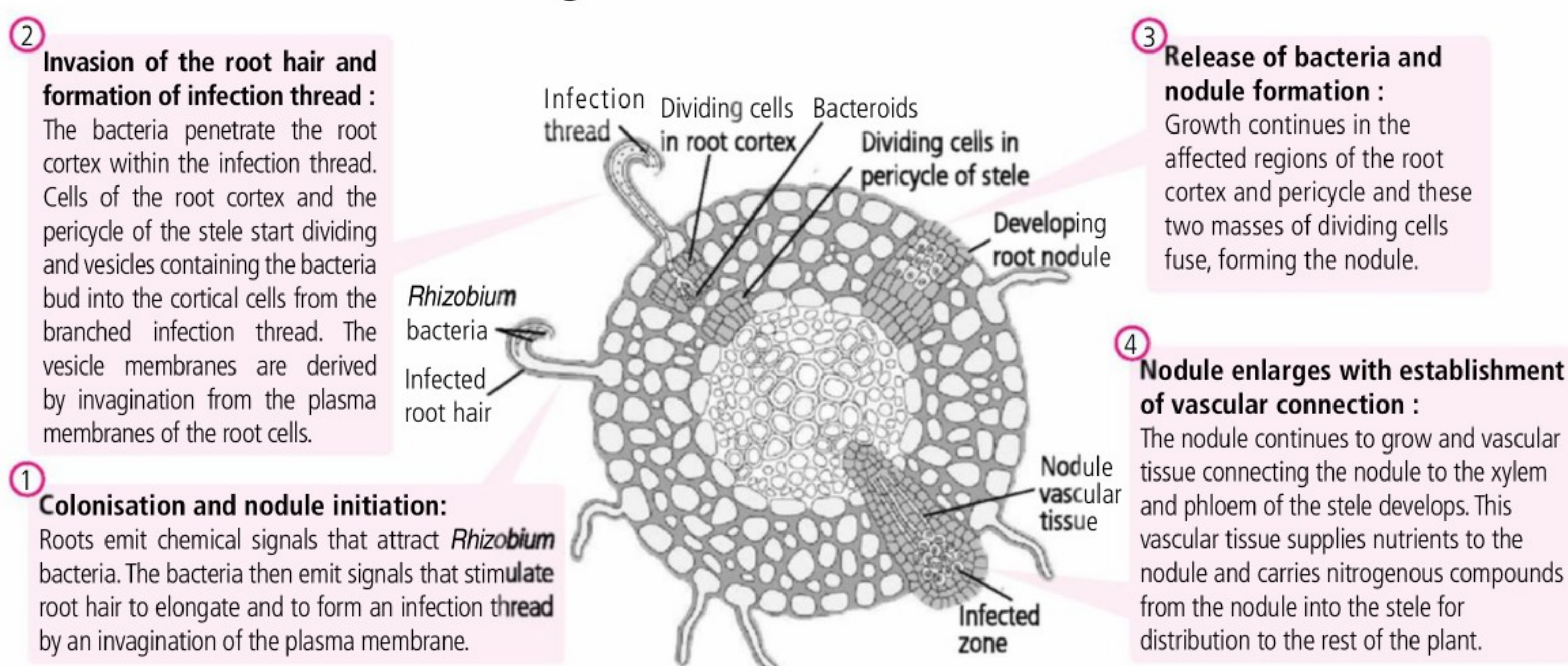


- Biological nitrogen fixation is major source of nitrogen fixation and second most important natural process. It is of two types carried out by two types of organisms, *i.e.*, free living and symbiotic.
- **Free living** : They live freely in the soil and perform nitrogen fixation, *e.g.*, *Azotobacter*, *Beijerinckia* (aerobic) and *Bacillus*, *Klebsiella*, *Clostridium* (anaerobic), *Desulphovibrio* (chemotrophic), *Rhodospirillum* and *Chromatium* (anaerobic photoautotrophic), *Anabaena*, *Nostoc*, *Aulosira* (Cyanobacteria in rice fields), *Cylindrospermum*

(Cyanobacteria in sugarcane and maize fields).

- **Symbiotic** : Symbiotic nitrogen fixation involves specific association between bacteria and roots of plant, forming multicellular structures, called nodules. *E.g.*, *Frankia* in root nodules of non leguminous plants *i.e.*, *Casuarina*, *Myrica*, *Alnus*, *Rhizobium* in root nodules of leguminous plants *i.e.*, *Sesbania rostrata*, *Aero-rhizobium* in stem nodules; *Xanthomonas* and *Mycobacterium* in leaves of members of Rubiaceae and Myrsinaceae. *Anabaena* and *Nostoc* in lichens, *Anthoceros*, *Azolla* and cycad roots.

Formation of Root Nodules in Leguminous Plants



- Nodule formation is stimulated by **auxin** produced by cortical cells and **cytokinin** liberated by invading bacteria.
- Host cell develops pinkish pigment called **leghaemoglobin** (oxygen scavenger), protects nitrogen fixing enzyme **nitrogenase** from oxygen.
- Symbiotic nitrogen fixation requires cooperation of *Nod* genes of legumes, *nod*, *nif* and *fix* gene clusters of bacteria.

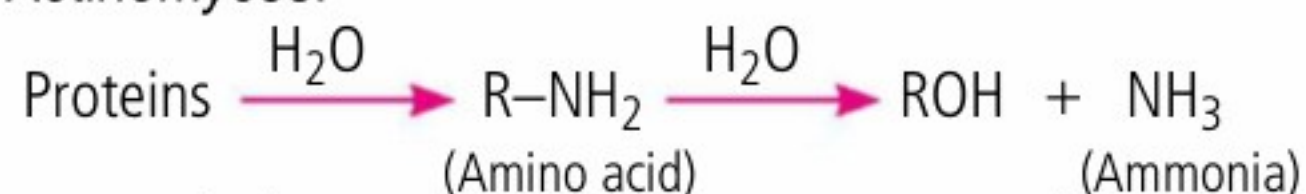
Mechanism of Nitrogen Fixation

- There are certain requirements for nitrogen fixation that includes reducing power (NADP, FMNH₂) source of energy (ATP), dinitrogenase enzyme.
- **Dinitrogenase enzyme** consisting of Fe and Mo. Both take part in attachment of N₂ molecule, so that the bonds between two atoms of nitrogen become weakened.
- The bond between the two atoms of nitrogen become weakened by their attachment to the metallic components. The weakened nitrogen molecule is acted upon by hydrogen from a reduced coenzyme.
- It produces **diimide** (N₂H₂), **hydrazine** (N₂H₄) and **ammonia** (not liberated).
- The nitrogen fixers protect themselves from toxic concentrations of ammonia by providing organic acids which reacts with ammonia to form amino acids.

- Ammonia + α -ketoglutarate + NAD(P)H $\xrightarrow{\text{Dehydrogenase}}$ Glutamate + NAD (P)⁺ + H₂O
 - The reduction of nitrogen into ammonia by nitrogenase in bacteroids depends upon availability of ATP and substrate capable of donating hydrogen atoms to nitrogen.
 - ATP interacts with non-heme iron protein component of nitrogenase and bring about conformational change to convert it to a powerful reductant.
 - This powerful reductant becomes capable of transferring electrons to reduce N₂ into NH₃.
 - Four molecules of ATP are hydrolysed for each pair of electrons transferred to nitrogen. Thus, reduction of one molecule of nitrogen into two molecules of ammonia require sixteen molecules of ATP.
- $$\text{N}_2 + 8\text{e}^- + 8\text{H}^+ + 16\text{ATP} \xrightarrow{\text{Dinitrogenase}} 2\text{NH}_3 + \text{H}_2 + 16\text{ADP} + 16\text{Pi}$$

Ammonification

- It is carried out by microorganisms causing decay. They act upon nitrogenous excretions and proteins of dead bodies of living organisms *e.g.*, *Bacillus ramosus*, *B. vulgaris*, *Actinomyces*.



- Ammonia does not remain in gaseous state but is changed to ionic form (NH_4^+) in the soil which is used by plants directly (if the pH of soil is less than 6 and plant contains abundant organic acids).

Nitrification

- It is the phenomenon of conversion of ammonium to nitrate. It is performed in two steps:
- **Nitrite formation** : Ammonium ions are oxidised to nitrites by bacteria *e.g.*, *Nitrosococcus*, *Nitrosomonas*.
$$2\text{NH}_3 + 3\text{O}_2 \longrightarrow 2\text{NO}_2^- + 2\text{H}^+ + 2\text{H}_2\text{O} + \text{Energy}$$
- **Nitrate formation** : Nitrites are changed to nitrates by bacteria *e.g.*, *Nitrocystis*, *Nitrobacter*.
$$2\text{NO}_2^- + \text{O}_2 \longrightarrow 2\text{NO}_3^- + \text{Energy}$$
- The nitrifying bacteria are chemoautotrophs since they use the liberated energy in synthesis of organic compounds.

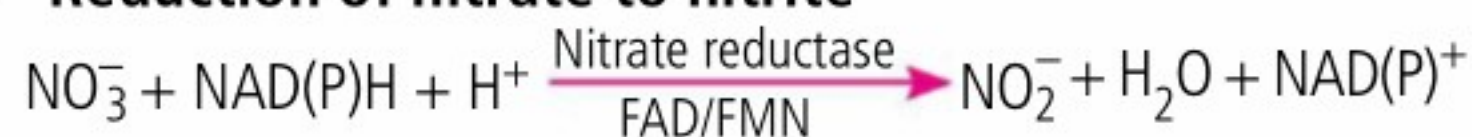
Denitrification

- Under anaerobic conditions, some microbes use nitrate and other oxidised ions as source of oxygen. In such process, nitrates are reduced to gaseous compounds of nitrogen, which escape from soil. *Pseudomonas denitrificans*, *Thiobacillus denitrificans*, *Micrococcus denitrificans* are examples of denitrifying bacteria.
- The process not only depletes nitrogen from soil but also causes its acidification.

Nitrate Assimilation

- The nitrates produced by nitrification are absorbed by higher plants and assimilated by the process called **nitrate assimilation**.
- The nitrates absorbed by plants get converted into amino acids and amides before incorporating into proteins and other macromolecules.
- It involves reduction of nitrate into ammonia by two enzymatic reactions:

– Reduction of nitrate to nitrite

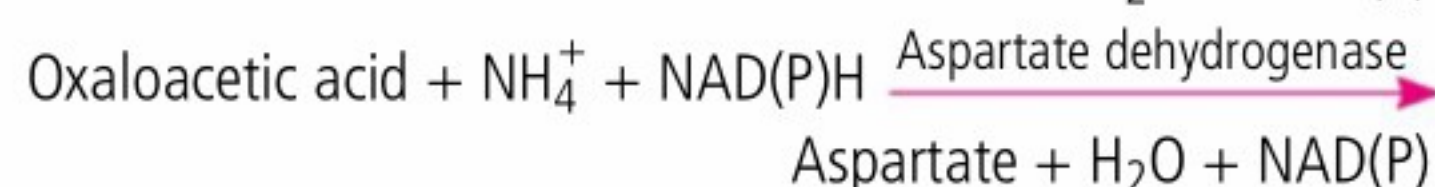
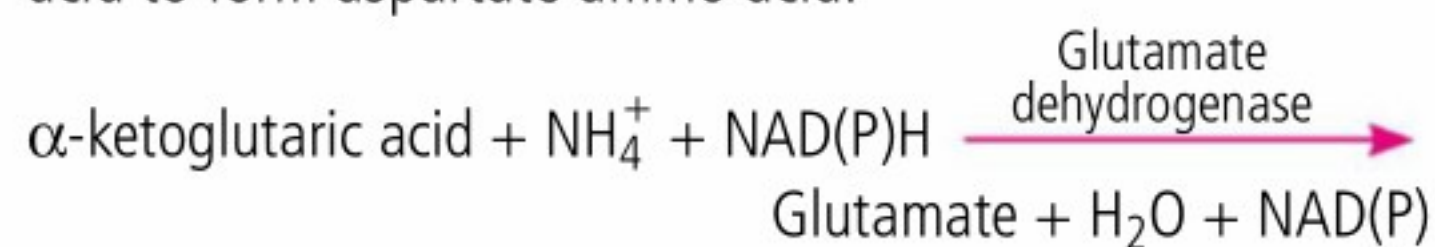


– Reduction of nitrite

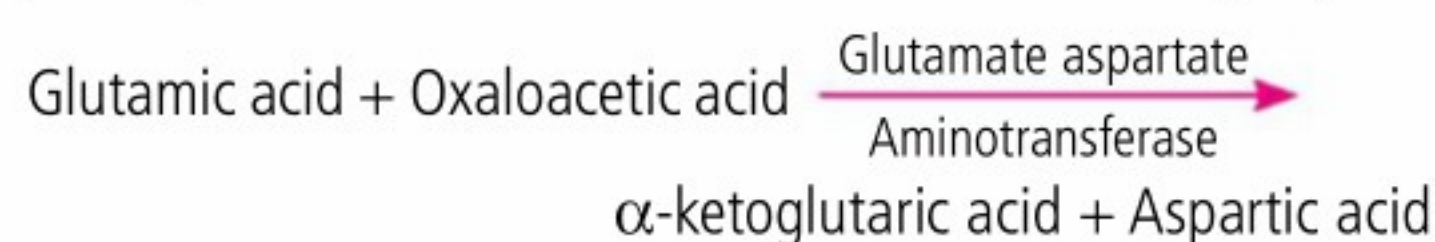


Synthesis of Amino Acids

- Ammonia liberated from reduction of nitrite combines with organic acids to produce amino acids.
- Amino acids are first organic compounds of nitrogen assimilation. These can be synthesised by reductive amination, catalytic amidation and transamination.
- In **reductive amination**, ammonia reacts with α -ketoglutaric acid to form glutamate or with oxaloacetic acid to form aspartate amino acid.



- In **catalytic amidation**, ammonia combines with glutamic acid in the presence of ATP to produce an amide - glutamine. Glutamine reacts with α -ketoglutaric acid to form 2 molecules of glutamate.
- Transamination** is transfer of amino group of one amino acid with the keto group of keto acid. Glutamic acid is the primary amino acid involved in transfer of amino group.



- The amino acids thus formed, further form the polypeptide chains by establishing peptide bonds between carboxylic group of one amino acid and amino group of an adjacent amino acid. The polypeptides give rise to proteins.

Amides

- They are amino acid derivatives in which $-\text{OH}$ component of carboxylic group ($-\text{COOH}$) is replaced by another amino group ($-\text{NH}_2$).
- The two most important amides are **asparagine** and **glutamine** that are formed by amidation of **aspartic acid** and **glutamic acid** respectively.
- Other functions of amide are storage of excess nitrogen and transportation.



INTEXT PRACTICE QUESTIONS

- Name 2 anaerobic free living bacteria involved in nitrogen fixation.
- What is the role of leghaemoglobin in nitrogen fixation?

CHECK YOUR VITALS

for NEET, AIIMS and JIPMER



Maximise your chance of success in medical entrance exams by reading this article. This section is specially designed to optimise your preparation by practising more and more. It is a unitwise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

- Recall question or single concept question – indicated by a single finger.
- Application question or question which requires 2 or 3 concepts - indicated by 2 fingers.
- Application question or question which requires 3 or more concepts - indicated by 3 fingers.

UNIT-V : HUMAN PHYSIOLOGY - I

CHAPTER-16 : DIGESTION AND ABSORPTION

Multiple Choice Questions

1. Which one of the following is the correct matching of the site of action, the substrate, the enzyme acting upon it and the end product ?
 - (a) Small intestine : proteins $\xrightarrow{\text{Pepsin}}$ amino acids
 - (b) Stomach : fats $\xrightarrow{\text{Lipase}}$ micelles
 - (c) Duodenum : triglycerides $\xrightarrow{\text{Trypsin}}$ monoglycerides
 - (d) Small intestine : starch $\xrightarrow{\text{Amylase}}$ disaccharides
2. Which one of the following pairs is correctly matched?
 - (a) Oxyntic cells - a secretion with pH between 2.0 and 3.0
 - (b) Alpha cells of islets of Langerhans - a secretion that decreases blood sugar level
 - (c) Kupffer cells - a digestive enzyme that hydrolyses nucleic acids
 - (d) Chief cells - a secretion that is rich in mucin.
3. If we take food rich in lime juice, then
 - (a) action of ptyalin on starch is enhanced
 - (b) action of ptyalin on starch is reduced
 - (c) action of ptyalin on starch is unaffected
 - (d) action of ptyalin on starch stops.
4. In which of the following order, the process of digestion proceeds ?
 - (a) Ingestion $\rightarrow$ Assimilation $\rightarrow$ Absorption $\rightarrow$ Accumulation
Egestion
 - (b) Digestion $\rightarrow$ Ingestion $\rightarrow$ Assimilation $\rightarrow$ Absorption $\rightarrow$ Egestion
 - (c) Ingestion $\rightarrow$ Digestion $\rightarrow$ Assimilation $\rightarrow$ Absorption $\rightarrow$ Egestion
 - (d) Ingestion $\rightarrow$ Digestion $\rightarrow$ Absorption $\rightarrow$ Assimilation $\rightarrow$ Egestion
5. Which sphincter guards the opening between the oesophagus and stomach?
 - (a) Gastroesophageal sphincter
 - (b) Pyloric sphincter
 - (c) Sphincter of Oddi
 - (d) Cardiac sphincter
6. Which enzymes are likely to act on the baked potatoes eaten by a man, starting from the mouth and as it moves down the alimentary canal?
 - (a) Pancreatic amylase $\rightarrow$ salivary amylase $\rightarrow$ lipases
 - (b) Disaccharidase like maltase $\rightarrow$ lipases $\rightarrow$ nucleases
 - (c) Salivary amylase $\rightarrow$ pancreatic amylase $\rightarrow$ disaccharidases
 - (d) Salivary maltase $\rightarrow$ carboxy-peptidase $\rightarrow$ trypsinogen
7. During the process of digestion, food is exposed to a range of pH. The relative pH of fluids in I, II and III regions of the alimentary canal shown in this diagram is
 - (a) $I > II < III$
 - (b) $I > II > III$
 - (c) $I < II < III$
 - (d) $I < II > III$
8. Which of the following are proteolytic enzymes?
 - (a) Ptyalin, trypsin, pepsin
 - (b) Lipase, erepsin, trypsin
 - (c) Erepsin, trypsin, pepsin
 - (d) Pepsin, nuclease, nucleotidase



9. In the gastrointestinal tract, the Meissner's plexus and the Auerbach's plexus occur respectively in the
- lamina propria and muscularis mucosa
 - submucosa and muscularis externa
 - submucosa and mucosa
 - mucosa and muscularis externa.

10. Which of the following is the function of enterogastrone?
- It inhibits the secretion of gastric juice.
 - It stimulates the secretion of digestive juices in the stomach.
 - It stimulates the flow of pancreatic juice.
 - It regulates the flow of bile.

11. Which of the following statements is correct?
- Argentaffin cells produce serotonin
 - Villikin is secreted by large intestine
 - Brunner's glands are found in jejunum
 - Succus entericus has pH of 2.8

12. If for some reason our goblet cells are non-functional, then which of the following will be adversely affected?
- Production of somatostatin
 - Production of secretin
 - Secretion of duocinin
 - Smooth movement of food down the intestine

13. Milk casein $\xrightarrow{Y}$ Paracasein + $M \longrightarrow$ Calcium paracaseinate
(Curdling of milk)

In the above question letters 'Y' and 'M' denote

- rennin and Ca^{++} respectively
 - Ca^{++} and rennin respectively
 - rennin, HCl and Ca^{++} respectively
 - renin and Ca^{++} respectively.
14. Which of the following statements are correct regarding secretion of oxyntic cells?
- It denatures proteins and softens fibrous connective tissues in the blood.
 - It activates rennin.
 - It renders calcium and iron salts suitable for absorption in the intestine.
 - It activates trypsin.
- (i) and (iv)
 - (ii), (iii) and (iv)
 - (i), (ii) and (iii)
 - (i), (iii) and (iv)
15. Which of the following statements is correct?
- The sight and smell of food while having your meal, enhances efficiency of digestion.
 - One should always have food till his/her stomach is completely full. This enhances digestion.
 - Drinking water while having meal enhances stretching effect on the stomach wall, hence enhances digestion.
 - None of these.

Match The Columns

16. Match Column I with Column II.

Column I

- Goblet cells
- Lysozyme
- Saliva
- Chief cells

Column II

- Antibacterial agent
- Mucus
- Pepsinogen
- Sublingual gland

17. Match Column I with Column II. (There can be more than one match for items in column I.)

Column I

- Bile salts
- Escherichia coli*
- Duocinin
- Vitamin A
- Steapsin

Column II

- Fatty acids and glycerol
- Hepatocytes
- Xerophthalmia
- Emulsification
- Colon
- Cobalamin
- Antioxidant
- Brunner's gland
- Soluble in water
- Duodenal epithelium

Passage Based Questions

- 18.(A) Complete the given passage with appropriate words or phrases.

Digestive glands play a crucial role in secretion of various enzymes and hormones. The duct of parotid glands in mouth, is called (i) duct. A viral infection of these glands is called (ii). (iii) of gastric glands secrete hydrochloric acid and (iv). pH of infant's gastric juice is (v). (vi) cells of liver are phagocytic as they eat up old and damaged WBCs, RBCs and bacteria. (vii) is an anticoagulant secreted by liver. Bile avoids decomposition of food as it is (viii). Alpha cells of pancreas produce a hormone called (ix). (x) cells are found in the bottom of crypts of Lieberkuhn.

- (B) Read the given passage and correct the errors, wherever present. The exocrine part of pancreas consists of groups of islets of Langerhans. They are most numerous in the head of the pancreas. Each islet of Langerhans consists of alpha cells (α -cells), beta cells (β -cells) and delta cells (δ cells). Alpha cells produce insulin hormone which converts glycogen into glucose in the small intestine. Beta cells produce glucagon hormone which converts glucose into glycogen in the duodenum and jejunum. Delta cells secrete secretin hormone which stimulates the secretion of glucagon and insulin.

Assertion & Reason

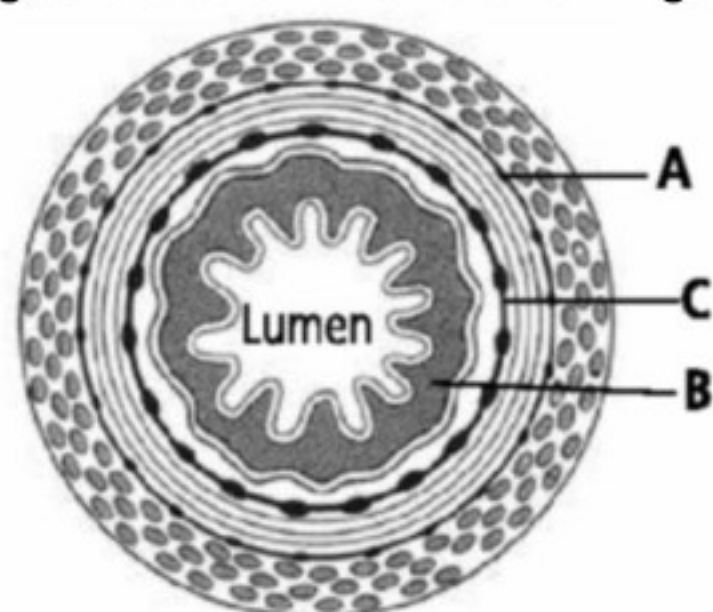
In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- If both A and R are true and R is the correct explanation of A
- If both A and R are true but R is not the correct explanation of A
- If A is true but R is false
- If both A and R are false.

19. **Assertion :** Many babies experience neonatal jaundice.
Reason : Neonatal jaundice is caused due to poor functioning of liver for a week after birth.
20. **Assertion :** Fatty acids are converted to chylomicrons and transferred into lymph capillaries called lacteals.
Reason : Fatty acids cannot be directly absorbed into blood capillaries by simple diffusion.
21. **Assertion :** Sodium glycocholate present in bile activates proelastase.
Reason : Sodium ions of sodium glycocholate act as cofactor of proelastase.
22. **Assertion :** Protein digestion starts in the stomach, not in the buccal cavity.
Reason : An absence of acidic environment in buccal cavity fails to activate proteases and peptidases.
23. **Assertion :** *E.coli* inhabits the colon but is not killed by body defense system.
Reason : *E.coli* produces cobalamin, thiamine and riboflavin.
24. **Assertion :** Peristalsis is the pushing of food through the oesophagus by muscular movement.
Reason : Persistaltic movement helps in breaking down of food particles into simpler substances.
25. **Assertion :** Pepsin activation is an autocatalytic reaction.
Reason : Activated pepsin itself changes pepsinogen into pepsin.
26. **Assertion :** Marasmus affects children below age of one year and the symptoms include prominent ribs, wrinkled skin and thin limbs.
Reason : Deficiency of proteins in diet causes marasmus.
27. **Assertion :** Neural control of digestion is regulated by vagus nerve.
Reason : Vagus nerve stimulation increases secretion of pancreatic juice.
28. **Assertion :** Infants are not able to control defecation.
Reason : In infants, defecation occurs by reflex action without the voluntary control of anal sphincter.

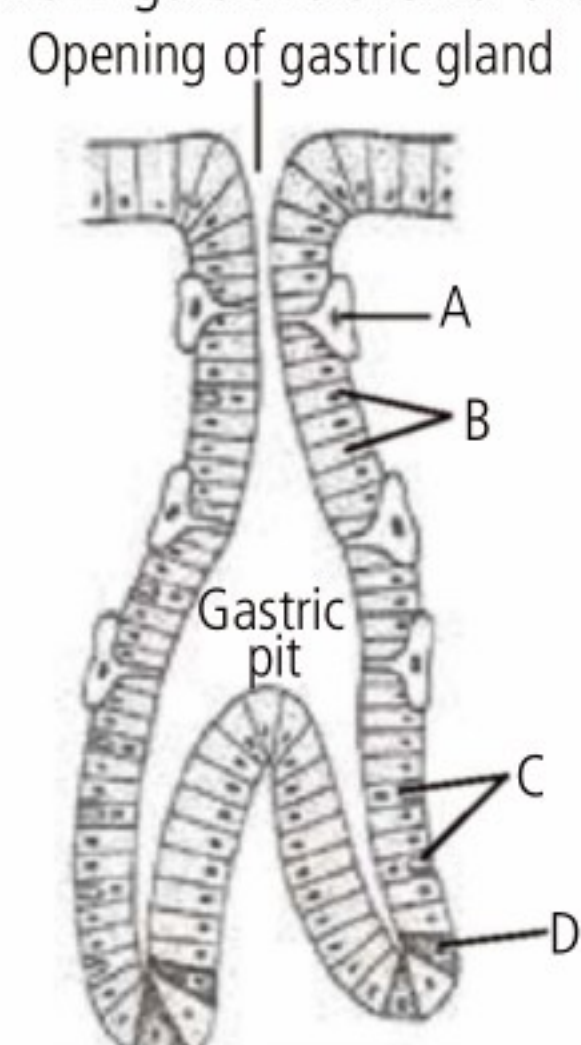
Figure Based Questions

29. Study the given diagrammatic representation of transverse section of gut and answer the following questions.



- (a) Identify the label A. What is its function?
 (b) Layer B is a mucosal layer and consists of blood vessels, connective tissue and lymphoid tissues. Identify B.
 (c) What does 'C' represent? In which layer is 'C' present?

30. Refer to the given figure and answer the following questions.



- (a) Identify A, B, C, and D in the given figure.
 (b) What will happen if A and B type of cells are removed from the stomach epithelium?

CHAPTER-17 : BREATHING AND EXCHANGE OF GASES

Multiple Choice Questions

1. About 1000 mL of air is always known to remain inside the human lungs. It is described as _____.
 (a) inspiratory reserve volume
 (b) expiratory reserve volume
 (c) residual volume (d) tidal volume
2. Inspiration occurs when there is a negative pressure in the lungs with respect to atmospheric pressure. This negative pressure is achieved when
 (a) intrapulmonary pressure is less than the atmospheric pressure
 (b) intrapulmonary pressure is greater than the atmospheric pressure
 (c) intrapulmonary pressure is equal to the atmospheric pressure
 (d) intrapleural pressure becomes more than the intra-alveolar pressure.
3. Between breaths the intrapleural pressure is approximately _____ mm Hg less than atmospheric pressure.
 (a) 1 (b) 4 (c) 8 (d) 10
4. Haldane effect plays an important role in promoting carbon dioxide transport than the Bohr's effect in promoting oxygen transport because
 (a) oxyhaemoglobin is a stronger acid which donates hydrogen ion (H^+) which in turn displace carbon dioxide from blood.
 (b) carbaminohaemoglobin is a stronger acid which splits into hydrogen ion (H^+) and bicarbonate (HCO_3^-).
 (c) carbon dioxide reacts with water to form carbonic acid that lowers the pH in tissue.
 (d) carbon dioxide is less soluble in venous blood than in arterial blood.

5. Select the correct order of the movement of fresh air into the lungs.

- (a) Nasal cavity → Pharynx → Larynx → Trachea → Bronchi → Bronchioles → Alveoli
- (b) Nasal cavity → Larynx → Pharynx → Trachea → Bronchioles → Bronchi → Alveoli
- (c) Nasal cavity → Larynx → Trachea → Pharynx → Bronchioles → Bronchi → Alveoli
- (d) Nasal cavity → Larynx → Pharynx → Trachea → Bronchioles → Bronchi → Alveoli

6. Which of the following symptoms is incorrect regarding emphysema?

- (a) Alveolar septa collapse
- (b) Regular coughing with thick greenish yellow sputum
- (c) Surface area of gas exchange decreases
- (d) Loss of elasticity in the walls of alveolar sacs

7. The binding of oxygen with haemoglobin tends to displace carbon dioxide from the blood. This phenomenon is known as

- (a) Bohr effect
- (b) Hamburger's phenomenon
- (c) oxygen dissociation curve
- (d) Haldane effect.

8. Visiting high mountains may cause altitude sickness in men living in plain areas. Prime cause of this is

- (a) excess of CO₂ in blood
- (b) decreased efficiency of haemoglobin
- (c) decreased partial pressure of oxygen
- (d) increased proportion of oxygen in air.

9. Identify the correct statement with reference to transport of respiratory gases by blood ?

- (a) Haemoglobin is necessary for transport of carbon dioxide and carbonic anhydrase for transport of oxygen
- (b) Haemoglobin is necessary for transport of oxygen and carbonic anhydrase for transport of carbon dioxide
- (c) Only oxygen is transported by blood
- (d) Only carbon dioxide is transported by blood

10. Which of the following changes occur in diaphragm and intercostal muscles when expiration of air takes place?

- (a) Internal intercostal muscles relax and diaphragm contracts.
- (b) Internal intercostal muscles contract and diaphragm relaxes.
- (c) External intercostal muscles and diaphragm relax.
- (d) External intercostal muscles and diaphragm contract.

11. Bohr's effect is related with

- (a) reduced carbon level in lymph
- (b) reduced oxygen level in haemoglobin
- (c) oxidised phosphorus level in blood
- (d) reduced carbon dioxide level in blood.

12. Select the incorrect statements.

- (a) 97% of oxygen is carried as oxyhaemoglobin in the blood.
- (b) 70% of carbon dioxide is transported as bicarbonate ions in blood plasma.

(c) 7% of carbon dioxide is transported in dissolved form in blood plasma.

(d) 5% of oxygen is transported by blood in dissolved form.

13. Read the following statements and select the correct one.

- I. The volume of gas that diffuses through the membrane per minute for a pressure difference of 1 mm Hg is defined as diffusing capacity.
- II. The high pCO₂ in deoxygenated blood allows the release of CO₂ from blood into the alveoli.
- III. Diffusion of oxygen is 20 times faster than CO₂ and that of CO₂ is two times faster than nitrogen at the particular pressure difference.
- IV. Binding of oxygen with haemoglobin is important in promoting CO₂ transport and its exchange in tissues and lungs.

- (a) I, II and IV
- (b) II, III and IV
- (c) III and IV
- (d) All of these

14. Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort?

- (a) One can breathe out air totally without oxygen.
- (b) One can breathe out air through Eustachian tube by closing both nose and mouth.
- (c) One can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.
- (d) The lungs can be made fully empty by forcefully breathing out all air from them.

15. Select the incorrectly matched pair.

- (a) Respiratory membrane - Capillary endothelium
- (b) Trachea - Ciliated cuboidal epithelium
- (c) Alveoli - Squamous epithelium
- (d) Larynx - Ciliated columnar epithelium

Match The Columns

16. Match Column I with Column II.

Column I	Column II
A. Residual volume	(i) Ratio of volume of CO ₂ evolved to the volume of O ₂ absorbed.
B. Tidal volume	(ii) Maximum volume of air that can be inhaled after a normal tidal expiration
C. Diffusing capacity	(iii) Volume of air inspired or expired during normal breath.
D. Inspiratory capacity	(iv) Volume of air remaining in lungs after forceful expiration
E. Respiratory quotient	(v) Limited gaseous exchange between alveoli and pulmonary blood.

17. Match Column I with Column II. (There can be more than one match for items in column I.)

Column I	Column II
A. Paranasal sinuses	(i) Main sites of gas exchange
B. Alveoli	(ii) Mucosa-lined air filled cavities in cranial bones
C. Larynx	(iii) Produce detergent like substance called surfactant
D. Bohr's effect	(iv) Thyroid cartilage
E. Pneumotaxic centre	(v) Moistens incoming air
F. Sneeze	(vi) Adam's apple in males
	(vii) Activation of pharyngeal and tracheal muscles to create large opening of nasal and oral cavities
	(viii) Displacement of oxygen from haemoglobin due to increased CO ₂
	(ix) Limits inspiration
	(x) Upper part of pons varolii
	(xi) Semi-autonomous expulsion of air
	(xii) Causes oxyhaemoglobin dissociation curve shift to right.

Passage Based Questions

- 18.(A) Complete the given passage with appropriate words or phrases.

The exchange of gases between lung alveoli and pulmonary capillaries is called (i). It occurs through (ii). This membrane consists of alveolar epithelium, (iii), a thin interstitial space, (iv) and (v). All these layers form a membrane of (vi) mm thickness. The respiratory membrane has a limit of gaseous exchange between alveoli and pulmonary blood called (vii). (vii) is dependent on (viii) of the diffusing gases. The diffusion of gases from a higher to lower concentration leads to the movement of (ix) from alveoli to (x).

- (B) Read the given passage and correct the errors, wherever present. Alveoli have very thick wall consisting of cuboidal epithelium. A film of lecithin lines the alveoli of lungs that increases the surface tension and keeps the alveoli closed. Exchange of O₂ and CO₂ at the alveoli and tissues occur by imbibition. The partial pressure of nitrogen is lower in the alveoli than in the deoxygenated blood. Most of the air facing surfaces of alveolar wall are lined by a layer of type I and type II alveolar cells. Type I alveolar cells produce a detergent-like substance called surfactant. Surfactant increases the surface tension of water layer at alveolar surface which decreases lung compliance, thereby making it easier for the lungs to expand.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A
(b) If both A and R are true but R is not the correct explanation of A
(c) If A is true but R is false
(d) If both A and R are false.

19. **Assertion :** Inspiration occurs when there is a negative pressure in the lungs with respect to the atmospheric pressure.

Reason : During inspiration, a decrease in pulmonary volume increases the intra-pulmonary pressure than atmospheric pressure which forces the air from outside to move into the lungs.

20. **Assertion :** Apneustic centre is located in the upper part of pons varolii and is considered hypothetical.

Reason : Its main job is to limit expiration.

21. **Assertion :** Haemoglobin acts as a buffer and prevents the pH of blood from fluctuating.

Reason : Most of the hydrogen ions of blood are neutralised by combination with haemoglobin forming acid haemoglobin, which reduces the acidity of blood.

22. **Assertion :** Bronchitis is caused by the exposure to air pollutants like CO.

Reason : This can be treated with suitable antibiotics and bronchodilator drugs.

23. **Assertion :** The exchange of gases between lung alveoli and pulmonary capillaries is called internal respiration.

Reason : The partial pressure of oxygen is lower in the alveoli than in the oxygenated blood in the capillaries of pulmonary arteries.

24. **Assertion :** Respiratory quotient for anaerobic respiration is infinity.

Reason : There is no consumption of oxygen but CO₂ is produced in most of the cases.

25. **Assertion :** In women, thoracic breathing is predominant.

Reason : Breathing in women occurs through lateral movement of thorax.

26. **Assertion :** Mammals show positive pressure breathing.

Reason : Positive pressure breathing reduces the chances of blocking the trachea to allow eating and breathing simultaneously.

27. **Assertion :** External intercostal muscle is considered as the principle muscle of inspiration.

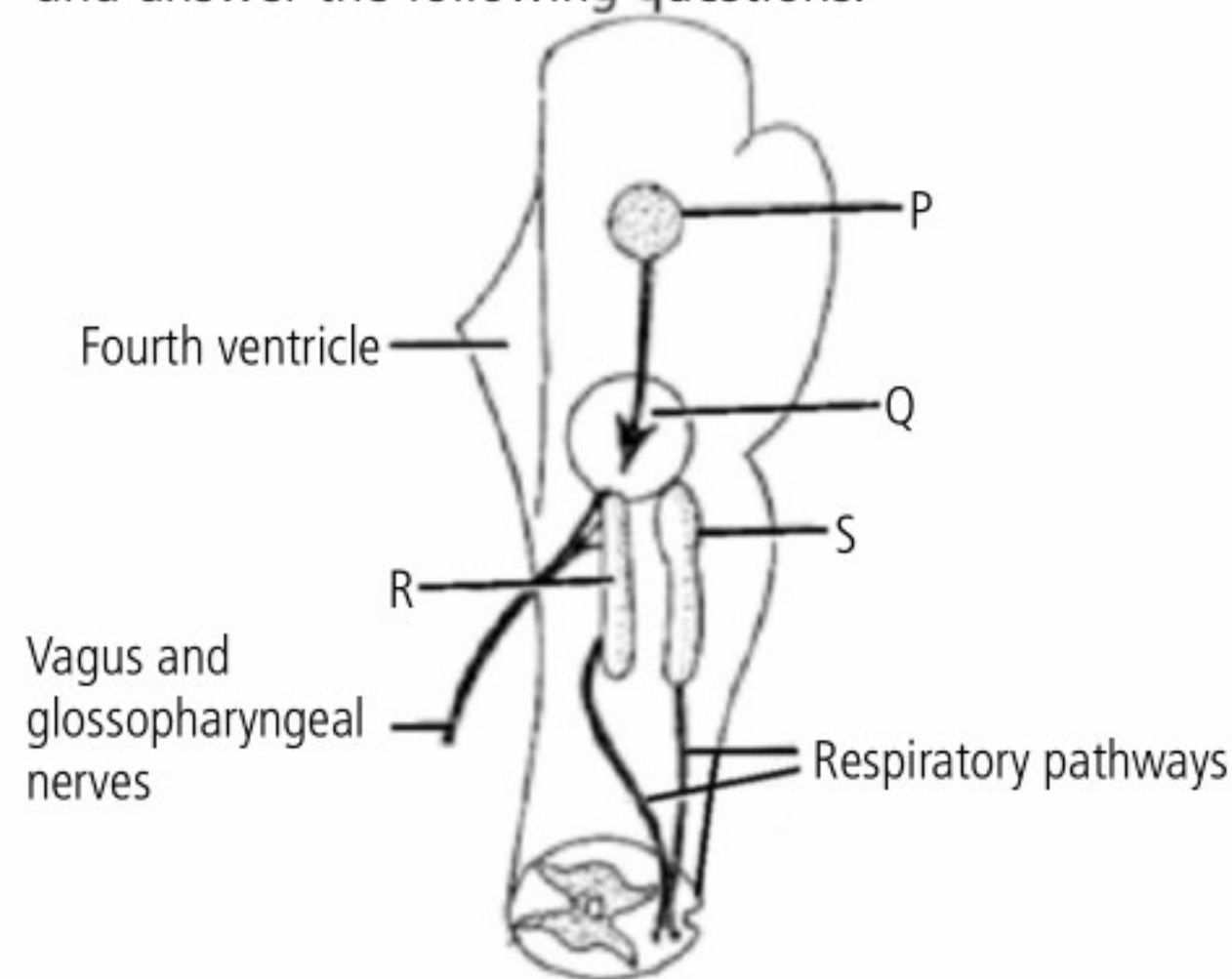
Reason : The external intercostal muscle contract to pull the ribs downward and inward increasing the volume of thoracic cavity.

28. **Assertion :** Exhalation becomes more difficult in patients of emphysema.

Reason : In emphysema patients, the surface area for gas exchange is greatly reduced.

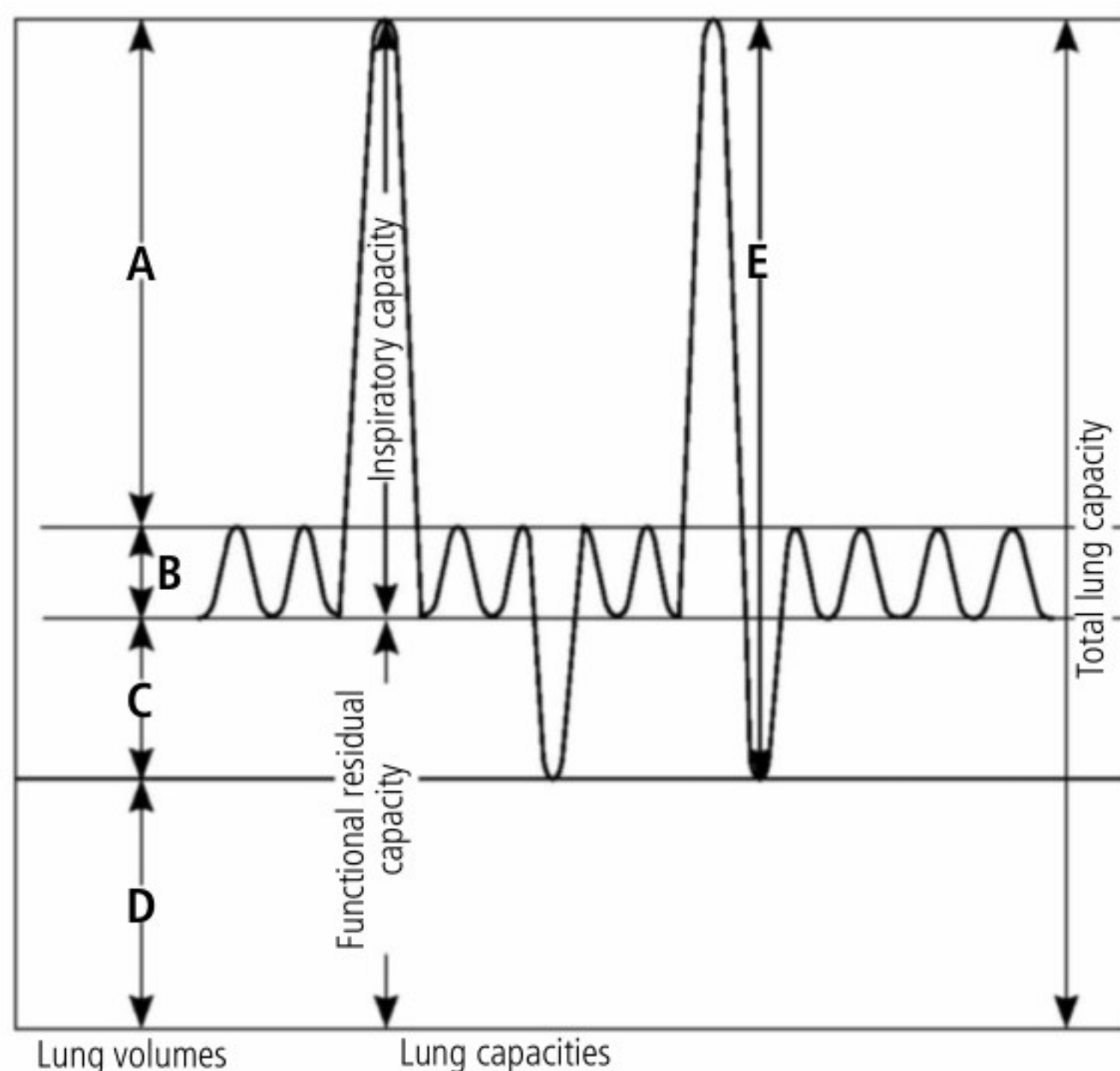
Figure Based Questions

29. Refer to the given figure of respiratory centres in humans and answer the following questions.



- (a) Identify P, Q, R and S in the given figure.
(b) Write one function each of P, Q, R and S.

30. Refer to the given graph and answer the following questions.



- (a) Identify A, B, C and D.
(b) Define D mentioned in the above graph and state its volume.
(c) Identify E and give the formula for calculating it. Suggest an example where volume of 'E' is found to be higher than normal.

CHAPTER-18 : BODY FLUIDS AND CIRCULATION

Multiple Choice Questions

1. Fetal blood would bypass the pulmonary circuit by flowing through the _____ located in the fetal interatrial wall.
(a) tricuspid atrioventricular valve
(b) ductus arteriosus

- (c) foramen ovale
(d) pulmonary semilunar valve

2. Which of the following statements about veins is correct?
(a) Venous valves are an extension of the tunica media.
(b) Up to one third of the total blood volume is stored in the venous circulation at any given time.
(c) Veins have small lumen as compared to arteries.
(d) The flow of venous blood is not a major result of one's blood pressure.

3. Immediately following strenuous and vigorous exercise, which of the following is most likely to occur?
(a) Blood will be rapidly diverted to the digestive organs.
(b) The skin will be cold and clammy.
(c) Capillaries of the active muscles will be engorged with blood.
(d) Blood flow to the kidneys quickly increases.

4. Blood flow to the skin
(a) is regulated mainly by a decreasing pH
(b) increases when external environmental temperature rises
(c) increases when internal body temperature decreases so that the skin does not freeze
(d) decreases when external environmental temperature rises.

5. Which of the following statements are incorrect?
(i) Leucocytes do not show diapedesis.
(ii) RBCs, WBCs and blood platelets are produced by bone marrow.
(iii) Neutrophils bring about destruction and detoxification of toxins of protein origin.
(iv) Important function of lymphocytes is to produce antibodies.
(a) (i) and (ii) (b) (i) and (iv)
(c) (i) and (iii) (d) (ii) and (iii)

6. You are viewing a heart dissected on a mid-frontal plane. All of the vessels leading into and away from the heart have been removed. The easiest way to determine the right and left sides is to
(a) find the opening of the coronary sinus
(b) notice the difference in thickness of the ventricle walls
(c) locate the pulmonary semilunar valves
(d) trace the pattern of the serous visceral pericardium.

7. Which of the following structures are directly involved in the "pulmonary circuit"?
(a) Superior vena cava, right atrium and left ventricle
(b) Right ventricle, pulmonary arteries and left atrium
(c) Left ventricle, aorta and inferior vena cava
(d) Right atrium, aorta and left ventricle

8. Read the following statements and select the correct option.
Statement 1 : Atria receive blood from all parts of the body which subsequently flows to ventricles.

Statement 2 : Action potential generated at sino-atrial node passes from atria to ventricles.

- (a) Both statements 1 and 2 are correct and statement 2 is the correct explanation of statement 1.
- (b) Both statements 1 and 2 are correct but statement 2 is not the correct explanation of statement 1.
- (c) Statement 1 is correct and statement 2 is incorrect.
- (d) Both statements 1 and 2 are incorrect.

9. Refer to the given electrocardiogram and select the correct statement.



- (a) It shows electrocardiogram of a healthy person.
- (b) It shows partial blockage due to damaged AV nodes.
- (c) It shows complete blockage and there is no synchrony between atrial and ventricular activities.
- (d) It shows that the muscles of heart are weak.

10. Which one of the following is the correct pathway for propagation of cardiac impulse ?

- (a) SA node → AV node → Bundle of His → Purkinje fibres
- (b) AV node → Bundle of His → SA node → Purkinje fibres
- (c) SA node → Purkinje fibres → AV node → Bundle of His
- (d) Purkinje fibres → AV node → SA node → Bundle of His

11. Cardiac activity could be moderated by the autonomous neural system. Which of the following statements is correct?

- (a) The parasympathetic system stimulates heart rate and stroke volume.
- (b) The sympathetic system stimulates heart rate and stroke volume.
- (c) The parasympathetic system decreases the heart rate but increases stroke volume.
- (d) The sympathetic system decreases the heart rate but increases stroke volume.

12. Select the incorrect match.

- (a) Heart attack - Death of heart muscle
- (b) Bradycardia - Slow heart beat
- (c) Thrombosis - Decreased blood flow to brain
- (d) Tachycardia - Fast heart beat

13. Which of the following statement(s) regarding the cardiac system is/are correct?

- (i) Human heart is an ectodermal derivative.
- (ii) Mitral valve guards the opening between the right atrium and left ventricle.
- (iii) SAN is located on the left upper corner of the right atrium.
- (iv) Stroke volume × Heart rate = Cardiac output.
- (a) (i) only
- (b) (i) and (ii)
- (c) (ii) and (iii)
- (d) (iv) only

14. 'X' is the rhythmic contraction and relaxation in the aorta and its main arteries. What is X?

- (a) Heart beat
- (b) Heart rate
- (c) Pulse
- (d) Cardiac output

15. Select the incorrect difference between open and closed circulatory system.

Open circulatory system

- (a) Blood flows at high pressure.
- (b) Exchange of material is direct.
- (c) It is less efficient.
- (d) Found in leech, prawns, etc.

Closed circulatory system

- Blood flows at low pressure.
- Exchange of material occurs through tissue fluid.
- It is more efficient.
- Found in earthworms, squids, etc.

Match The Columns

16. Match Column I with Column II.

Column I

- A. Rheumatic heart disease
- B. Spleen
- C. Lubb
- D. Opening of coronary sinus
- E. Strokes-Adams syndrome

Column II

- (i) Closure of bicuspid and tricuspid valves
- (ii) Thebesian valve
- (iii) *Streptococcus* bacteria
- (iv) Decreased flow of blood to brain
- (v) Haemopoiesis

17. Match Column I with Column II. (There can be more than one match for items in column I.)

Column I

- A. Lymphocytes
- B. Monocytes
- C. Eosinophils
- D. Basophils
- E. Neutrophils

Column II

- (i) Nucleus is usually 3-lobed
- (ii) Produce antibodies to kill microbes
- (iii) Largest of all types of leucocytes
- (iv) Their number increases in people with allergic conditions such as asthma
- (v) Kill tumour cells and are involved in graft rejections
- (vi) Nucleus is bean shaped
- (vii) Their cytoplasm contains granules which take acidic stains
- (viii) In female mammals, they possess barr body attached to the nucleus by a stalk
- (ix) They release heparin, serotonin and histamine
- (x) They are most numerous of all leucocytes

Passage Based Questions

- 18.(A)** Complete the given passage with appropriate words or phrases.

Heart beat is the rhythmic contraction and relaxation of the heart. Rate of heart beat is under neural and hormonal regulation. The cardiac centre lies in (i) of the brain. The cardio-inhibitor is connected with the heart through (ii) and cardio-accelerator through (iii). (iv) hormone accelerates heart beat under normal conditions, while hormone (v) does same function during emergency. These hormones directly influence (vi). (vii) hormone secreted by thyroid gland increases oxidative metabolism of body cells.

- (B)** Read the given passage and correct the errors, wherever present.

The mammalian heart is neurogenic. It means that heart beat originates from a muscle, however it is regulated by nerves. The heart beat originates from atrioventricular node or pacemaker. Another neuromuscular tissue, sinoatrial node or pacesetter picks up the wave of contraction. The discharge rate of sinoatrial node is slower than natural self-excitatory discharge rate of atrioventricular node. Bundle of His originates from atrioventricular node and is divided into fine fibres called Purkinje fibres. These convey impulse of contraction to the myocardium of atria. If the pacemaker of the heart becomes defective then an ectopic pacemaker may be implanted in the patient's abdomen which stimulates the heart electrically to beat at normal rate.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A
(b) If both A and R are true but R is not the correct explanation of A
(c) If A is true but R is false
(d) If both A and R are false.

- 19. Assertion :** Type 'O' blood group individuals are called 'universal donors'.

Reason : RBCs of 'O' blood group have both 'A' and 'B' surface antigens.

- 20. Assertion :** Mitral valve is located between right atrium and right ventricle.

Reason : Tricuspid valve is located between left atrium and left ventricle.

- 21. Assertion :** Vagal stimulation mainly decreases the heart rate, however its effect on heart contraction is not much pronounced.

Reason : The vagal fibres of vagus nerve which connects cardio-inhibitor of cardiac centre to heart are distributed mainly to the atria and not much to ventricles, where power of contraction of heart lies.

- 22. Assertion :** Blood clotting can be prevented in a test tube by adding a little oxalate.

Reason : Oxalate ions bind with Mg^{++} ions and prevent them from forming prothrombinase.

- 23. Assertion :** Atherosclerosis occurs when there is fat deposition in tunica interna of large arteries.

Reason : Atherosclerosis is indicated by a flat T-wave in an electrocardiogram.

- 24. Assertion :** Foramen ovale is the opening between two atria in fetus.

Reason : Foramen ovale compensates for the underdeveloped pulmonary circulation.

- 25. Assertion :** Aortic semilunar and pulmonary semilunar valves are open during joint diastole stage.

Reason : The opening of these valves results in filling the right and left ventricles with blood.

- 26. Assertion :** Marriage between Rh^- woman and Rh^+ man results in incompatibility during pregnancy.

Reason : Rh^- blood of mother stimulates formation of Rh antibodies in fetal blood.

- 27. Assertion :** Deficiency of vitamin K causes blood loss during an injury.

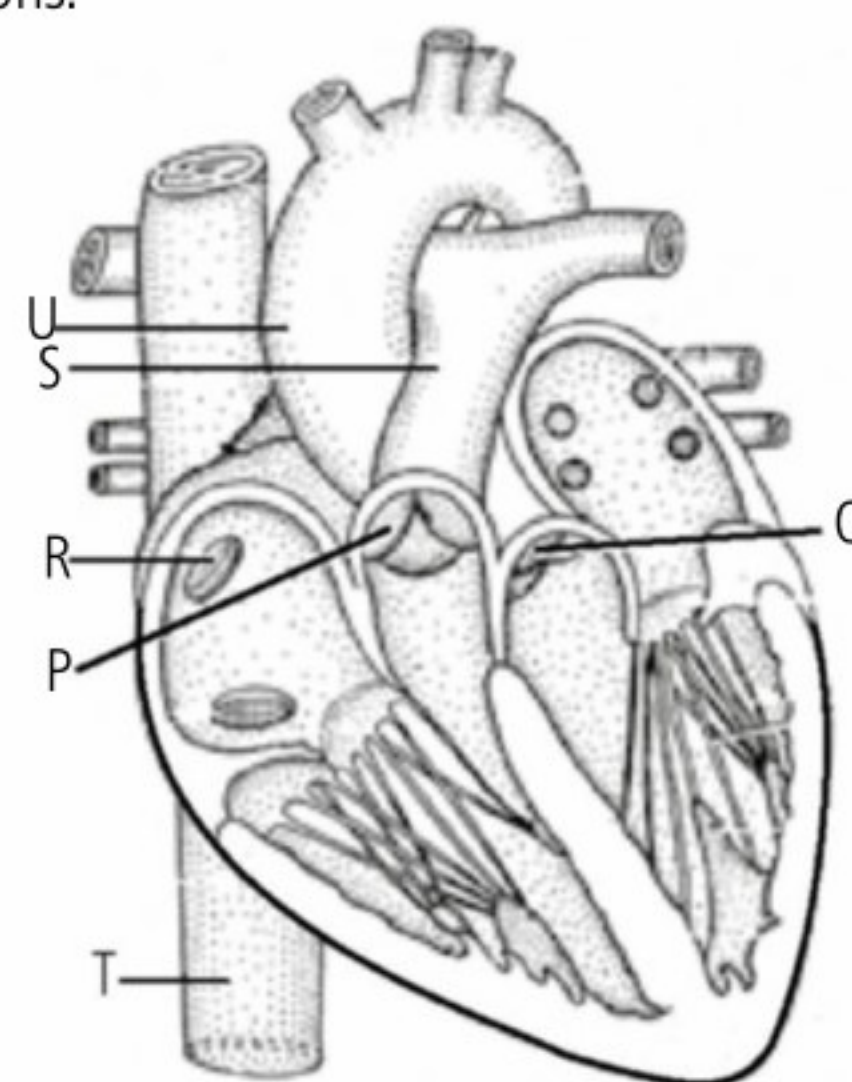
Reason : Vitamin K is essential for synthesis of prothrombin.

- 28. Assertion :** There is no mixing of oxygenated and deoxygenated blood in the human heart.

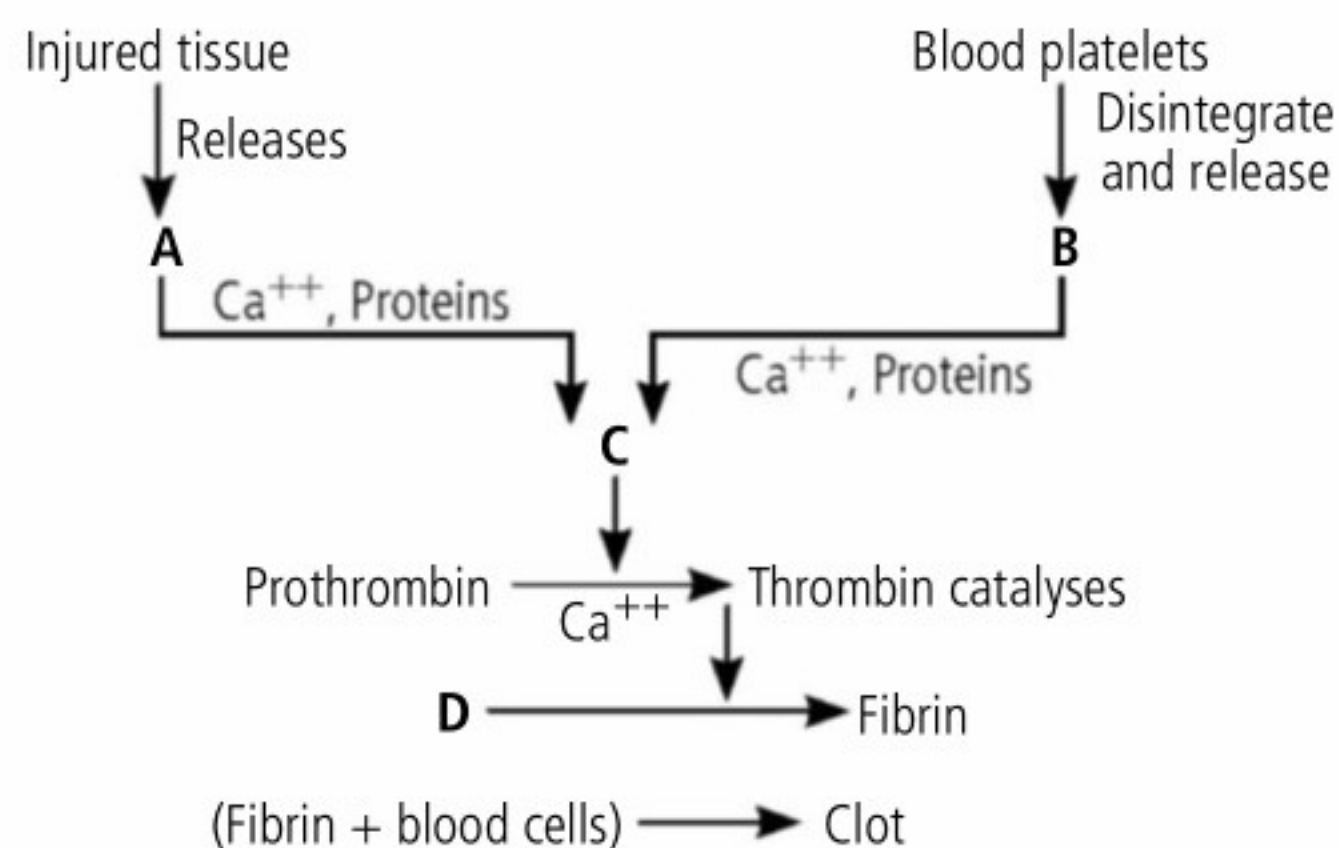
Reason : Valves are present in the heart which allow the movement of blood in one direction only.

Figure Based Questions

- 29.** Refer to the given figure and answer the following questions.



- (a) Identify P, Q, R, S, T and U in the given figure.
(b) Briefly describe the location and function of P and Q.
(c) Which out of S, T and U contains oxygenated blood only?
- 30.** Study the given flow chart of blood clotting and answer the following questions.



- What does A and B represent?
- Identify enzyme C formed from A and B.
- Thrombin acts as enzyme and brings depolymerisation of D. Identify D and state its significance.

CHAPTER-19 : EXCRETORY PRODUCTS AND THEIR ELIMINATION

Multiple Choice Questions

- A fall in glomerular filtration rate (GFR) activates
 - juxtaglomerular cells to release renin
 - heart to release atrial natriuretic factor
 - adrenal medulla to release adrenaline
 - posterior pituitary to release vasopressin.
- When 2 to 3 drops of Benedict's reagent are added to a urine sample and heated gently, it turns yellow. This colour change indicates that
 - urine contains 2% glucose
 - urine contains 0.5% glucose
 - urine contains 1.5% glucose
 - urine contains 1% glucose.
- Pick the odd ones in each of the following groups and select the correct option.

(i)	(ii)	(iii)	(iv)
(a) Renal pelvis	Juxta glomerular cells	Collecting duct	Distal convoluted tubule
(b) Renal papilla	Lacis cells	Antidiuretic hormone	Henle's loop
(c) Medullary pyramid	Macula densa	Hypertonic urine	Proximal convoluted tubule
(d) Renal cortex	Duct of Bellini	Glomerular filtration	Renal corpuscle
- Which of the following excretory organ is correctly matched with the organism in which it is found?
 - Nephridia – Crustaceans
 - Malpighian tubules – Annelids
 - Antennal gland or green glands – Insects
 - Flame cells – Platyhelminthes
- If Henle's loop were absent from mammalian nephron, which of the following is to be expected?
 - There will be no urine formation.
 - There will be hardly any change in the quality and quantity of urine formed.
 - The urine will be more concentrated.
 - The urine will be more dilute.
- Net filtration pressure of kidney can be derived by the equation : (Where GBHP → Glomerular blood hydrostatic pressure, BCOP → Blood colloidal osmotic pressure; CHP → Capsular hydrostatic pressure)
 - $NFP = GBHP + (BCOP - CHP)$
 - $NFP = BCOP - (GBHP + CHP)$
 - $NFP = GBHP - (BCOP + CHP)$
 - $NFP = BCOP + (GBHP - CHP)$.
- Which of the following parts of renal tubule correctly matches with the osmotic concentration of filtrate present in it with respect to blood plasma?
 - PCT → Hypotonic
 - Ascending limb of loop of Henle → Hypertonic
 - Descending limb of loop of Henle → Hypotonic
 - DCT → Isotonic
- Antidiuretic hormone is released from the hypothalamus when osmolarity of blood
 - increases above 300 mOsmolL^{-1}
 - decreases below 300 mOsmolL^{-1}
 - increases above 160 mOsmolL^{-1}
 - decreases below 100 mOsmolL^{-1} .
- Which of the following conditions causes filling of urinary bladder?
 - Relaxation of detrusor muscle of urinary bladder and internal sphincter.
 - Constriction of detrusor muscle of urinary bladder and internal sphincter.
 - Relaxation of detrusor muscle of urinary bladder and constriction of internal sphincter.
 - Contraction of detrusor muscle of urinary bladder and relaxation of internal sphincter.
- Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?
 - Increase in aldosterone levels
 - Increase in antidiuretic hormone levels
 - Decrease in aldosterone levels
 - Decrease in antidiuretic hormone levels

11. Distal convoluted tubule is lined by
 (a) cuboidal cells (b) epithelial cells
 (c) transitional epithelial cells
 (d) ciliated cells.

12. Which one of the following statements is correct with respect to kidney function regulation?
 (a) When someone drinks lots of water, ADH release is suppressed.
 (b) Exposure to cold temperature stimulates ADH release.
 (c) An increase in glomerular blood flow stimulates formation of angiotensin II.
 (d) During summer when body loses lot of water by evaporation, the release of ADH is suppressed.

13. Which of the following statements is/are true for Bowman's capsule?
 I. It is a single layered cup-shaped structure.
 II. Its lumen is continuous with broad lumen of the renal tubule.
 III. Its layer consists of a special type of cells called podocytes.
 (a) I and II only (b) II only
 (c) III only (d) All of these

14. Select the incorrect statement.
 (a) Tubular reabsorption takes place by passive and active transport.
 (b) ADH decreases the reabsorption of water in the DCT and collecting duct.
 (c) Cortical nephrons control plasma volume under normal water supply.
 (d) A normal adult person secretes about 1.5 litres of urine in 24 hours.

15. Presence of blood cells in urine is called
 (a) haemoglobinuria (b) hematuria
 (c) pyuria (d) uremia.

Match The Columns

16. Match Column I with Column II.

Column I	Column II
A. PCT	(i) Transitional epithelium
B. Urinary bladder	(ii) Cuboidal epithelial cells
C. JGA	(iii) Counter current mechanism
D. Glomerulus	(iv) Filtration
E. Loop of Henle	(v) Renin

17. Match Column I with Column II. (There can be more than one match for items in column I.)

Column I	Column II
A. Lungs	(i) Bilirubin
B. Sebaceous gland	(ii) Uric acid
C. Liver	(iii) CO ₂
D. Kidney	(iv) Waxes

- (v) Cholesterol
 (vi) Biliverdin
 (vii) Creatinine
 (viii) Sterols

Passage Based Questions

- 18.(A) Complete the given passage with appropriate words or phrases.

In the kidney, renal artery divides into the (i) which enters into (ii) to form glomerulus. An (iii) arises from the glomerulus which further divides to form peritubular capillaries. The (iii) and peritubular capillaries technically constitute a (iv). The smooth muscle cells of both (i) and (ii) are called (v), which are swollen and contain dark granules. These granules are mainly composed of inactive enzyme (vi) that converts (vii) into (viii). (viii) increases blood pressure and stimulates the secretion of (ix) by the adrenal cortex which further influences the active reabsorption of (x) from the filtrate.

- (B) Read the given passage and correct the errors, wherever present.

As blood pressure decreases, the cells of the juxtaglomerular apparatus releases the enzyme Atrial Natriuretic Factor (ANF). It converts angiotensin I into angiotensinogen. Renin then converts angiotensinogen into angiotensin II. Angiotensin I increases the synthesis and release of aldosterone, decreases blood pressure by dilating blood vessels and stimulates sodium reabsorption by PCT.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :

- (a) If both A and R are true and R is the correct explanation of A
 (b) If both A and R are true but R is not the correct explanation of A
 (c) If A is true but R is false
 (d) If both A and R are false.

19. **Assertion :** The cells of proximal convoluted tubule have numerous mitochondria near the basolateral surface.

Reason : Reabsorption of salts takes place by active transport.

20. **Assertion :** The epithelium of visceral layer of glomerular membrane is lined with foot cells.

Reason : The space between pedicels of foot cells helps in glomerular filtration.

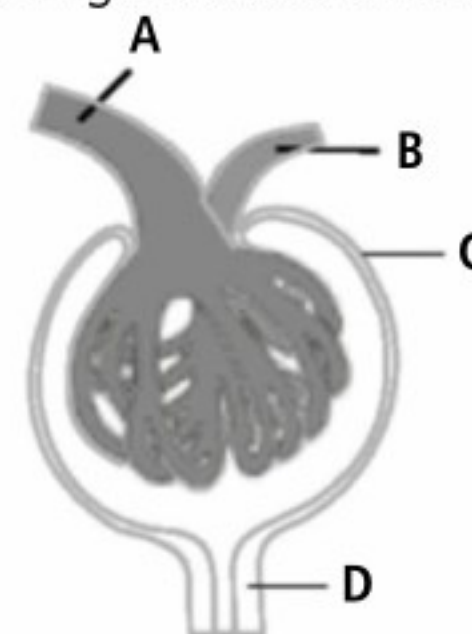
21. **Assertion :** Close association of cells of DCT and afferent and efferent arterioles is called macula densa.

Reason : Macula densa acts as chemoreceptors and feed information to the juxtaglomerular cells.

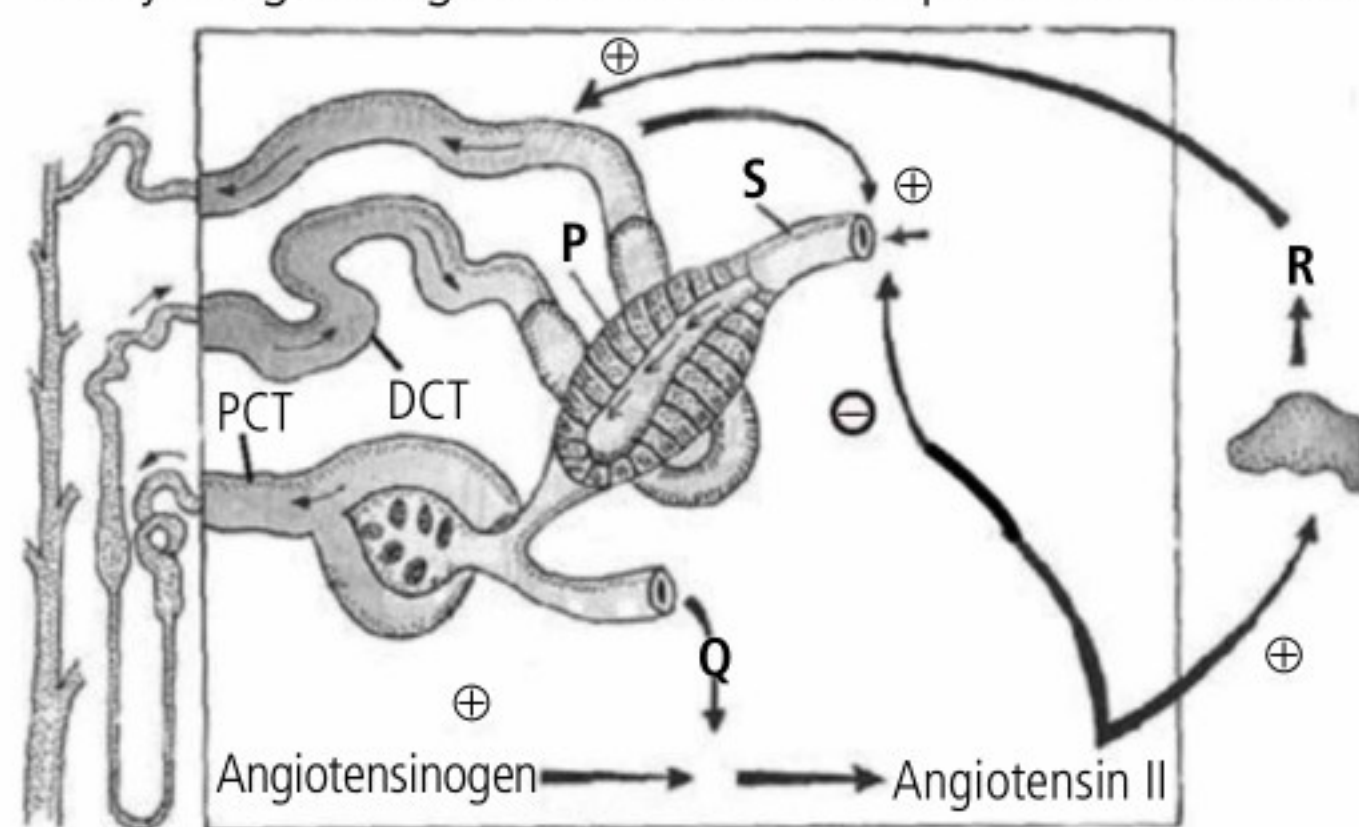
- 22. Assertion :** In the descending limb of loop of Henle, the urine is hypertonic, while in ascending limb of loop of Henle, the urine is hypotonic.
Reason : Descending limb is permeable to water while ascending limb is permeable to Na^+ .
- 23. Assertion :** Liver is referred to as the primary excretory organ in vertebrates.
Reason : Liver helps kidneys in the secretion of urine.
- 24. Assertion :** Glomerular filtration does not require the expenditure of energy by kidney cell.
Reason : The pressure of the blood flowing in the glomerular capillaries is lower than the pressure of the filtrate in Bowman's capsule.
- 25. Assertion :** Fruits increase acidity of urine.
Reason : Vegetables increase alkalinity of urine.
- 26. Assertion :** Walls of atria of the heart release ANF in response to increase in blood volume and pressure.
Reason : ANF stimulate release of renin thereby stimulating NaCl reabsorption in collecting duct.
- 27. Assertion :** Blood osmotic pressure of shark approaches sea water osmotic pressure.
Reason : Sharks retain large quantity of urea in their blood.
- 28. Assertion :** Urine contains mostly waste materials and excess water.
Reason : Tubular reabsorption is the second process in the formation of urine from filtrate.

Figure Based Questions

- 29.** Refer to the given figure and answer the following questions.



- (a) Identify A, B, C and D in the given figure.
 (b) Identify and briefly explain the process which takes place in the part of renal tubule shown in the figure.
- 30.** Study the given figure and answer the questions that follow.



- (a) Identify P, Q, R and S in the given figure.
 (b) State the relationship between P and Q. How does Q controls urine formation?

SOLUTIONS

CHAPTER-16 : DIGESTION AND ABSORPTION

1. (d) 2. (a) 3. (b) 4. (d) 5. (a)
 6. (c) 7. (a) 8. (c) 9. (b) 10. (a)
 11. (a) 12. (d) 13. (a) 14. (c) 15. (a)
 16. A-(ii), B-(i), C-(iv), D-(iii)
 17. A-(ii, iv), B-(v, vi), C-(viii, x), D-(iii, vii), E-(i, ix)
 18. (A) (i) Stenson's (ii) mumps
 (iii) Oxyntic cells (iv) Castle intrinsic factor
 (v) 5 (vi) Kupffer
 (vii) Heparin (viii) alkaline
 (ix) glucagon (x) Paneth
 (B) The ~~exocrine~~ endocrine part of pancreas consists of groups of islets of Langerhans. They are most numerous in the ~~head~~ tail of the pancreas. Each islet of Langerhans consists of alpha cells (α -cells), beta cells (β -cells) and delta cells (δ cells). Alpha cells produce ~~insulin~~ glucagon hormone which converts glycogen into glucose in the ~~small intestine~~ liver. Beta cells produce ~~glucagon~~ insulin hormone which

converts glucose into glycogen in the ~~duodenum~~ liver and ~~jejunum~~ muscles. Delta cells secrete ~~secretin~~ somatostatin hormone which ~~stimulates~~ inhibits the secretion of glucagon and insulin.

19. (a) 20. (c) 21. (d) 22. (c) 23. (b)
 24. (c) 25. (a) 26. (b) 27. (c) 28. (a)
 29. (a) A represents Auerbach's plexus, present in muscularis layer. Auerbach's plexus controls peristalsis.
 (b) Layer B is lamina propria.
 (c) C is Meissner's plexus present in submucosa layer of wall of alimentary canal.
 30. (a) A – Oxyntic cell / parietal cell
 B – Chief cells
 C – Mucous cells
 D – Argentaffin cell
 (b) A (Oxyntic cell) secretes hydrochloric acid and Castle's intrinsic factor whereas B (chief cell) secretes digestive enzymes pepsinogen and prorennin (as proenzymes). If under certain conditions, these cells are removed from gastric epithelium,

then HCl and digestive enzymes will be absent in the gastric juice. In this situation there will be no digestion of food in stomach and the undigested food will pass as such into the lumen of small intestine. Moreover Castle's intrinsic factor plays an important role in absorption of vitamin B₁₂ in small intestine. In the absence of this factor, vitamin B₁₂ absorption will be hampered.

CHAPTER-17 : BREATHING AND EXCHANGE OF GASES

1. (c) 2. (a) 3. (b) 4. (a) 5. (a)
6. (b) 7. (d) 8. (c) 9. (b) 10. (b)
11. (b) 12. (d) 13. (a) 14. (c) 15. (b)
16. A-(iv), B-(iii), C-(v), D-(ii), E-(i)
17. A-(ii, v), B-(i, iii), C-(iv,vi), D-(viii, xii), E-(ix, x), F-(vii, xi)
- 18.(A) (i) external respiration (ii) respiratory membrane
 (iii) epithelial basement membrane (iv) capillary basement membrane
 (v) capillary endothelium (vi) 0.2
 (vii) diffusing capacity (viii) solubility
 (ix) oxygen (x) blood
- (B) Alveoli have very ~~thick~~ thin wall consisting of ~~cuboidal~~ squamous epithelium. A film of lecithin lines the alveoli of lungs that ~~increases~~ lowers the surface tension and keeps the alveoli ~~closed~~ open. Exchange of O₂ and CO₂ at the alveoli and tissues occur by ~~imbibition~~ diffusion. The partial pressure of nitrogen is ~~lower~~ same in the alveoli as in the deoxygenated blood. Most of the air facing surfaces of alveolar wall are lined by a layer of type I and type II alveolar cells. ~~Type-I~~ Type II alveolar cells produce a detergent-like substance called surfactant. Surfactant ~~increases~~ reduces the surface tension of water layer at alveolar surface which ~~decreases~~ increases lung compliance, thereby making it easier for the lungs to expand.
19. (c) 20. (d) 21. (a) 22. (c) 23. (c)
24. (a) 25. (a) 26. (d) 27. (c) 28. (b)
29. (a) P – Pneumotaxic centre
 Q – Apneustic centre
 R – Dorsal respiratory group of neurons
 S – Ventral respiratory group of neurons
- (b) P - (Pneumotaxic centre) sends signals to all the neurons of dorsal respiratory group and only to inspiratory of ventral respiratory group. Its main job is to primarily limit inspiration.
 Q - (Apneustic centre) works in collaboration with pneumotaxic centre to control the depth of inspiration.
 R - (Dorsal respiratory group of neurons) mainly causes inspiration and controls the contraction of intercostal muscles and muscles that flatten the diaphragm to cause inspiration.

S - (Ventral respiratory group of neurons) send signals for both inspiration and expiration.

30. (a) A - Inspiratory reserve volume (IRV)
 B - Tidal volume (TV)
 C - Expiratory reserve volume (ERV)
 D - Residual volume (RV)
- (b) Residual volume is the volume of air which still remains in the lungs after the most forceful expiration. Its volume is about 1100 ml to 1200 ml.
- (c) E is vital capacity. It is defined as the maximum volume of air a person can breathe in after a forced expiration or maximum volume of air a person can breathe out after forced inspiration.
 It can be calculated as $VC = TV + IRV + ERV$.
 (Tidal Volume + Inspiratory Reserve Volume + Expiratory Reserve Volume)
 Its capacity varies from 3400 mL to 4800 mL.
 Vital capacity is observed to be higher in athletes and mountain dwellers.

CHAPTER-18 : BODY FLUIDS AND CIRCULATION

1. (c) 2. (d) 3. (c) 4. (b) 5. (c)
6. (b) 7. (b) 8. (b) 9. (b) 10. (a)
11. (b) 12. (c) 13. (d) 14. (c) 15. (a)
16. A-(iii), B-(v), C-(i), D-(ii), E-(iv)
17. A-(ii, v), B-(iii, vi), C-(iv,vii), D-(i, ix), E-(viii, x)
- 18.(A) (i) medulla oblongata (ii) vagus nerve
 (iii) sympathetic nerve fibre (iv) Noradrenaline
 (v) adrenaline (vi) sino-atrial node
 (vii) Thyroxine
- (B) The mammalian heart is ~~neurogenic~~ myogenic. It means that heart beat originates from a muscle, however it is regulated by nerves. The heart beat originates from ~~atrioventricular~~ sinoatrial node or pacemaker. Another neuromuscular tissue, ~~sinoatrial~~ atrioventricular node or pacesetter picks up the wave of contraction. The discharge rate of sinoatrial node is ~~slower~~ faster than natural self-excitatory discharge rate of atrioventricular node. Bundle of His originates from atrioventricular node and is divided into fine fibres called Purkinje fibres. These convey impulse of contraction to the myocardium of ~~atria~~ ventricles. If the pacemaker of the heart becomes defective then an ~~ectopic~~ artificial pacemaker may be implanted in the patient's ~~abdomen~~ chest which stimulates the heart electrically to beat at normal rate.
19. (c) 20. (d) 21. (a) 22. (c) 23. (b)
24. (a) 25. (d) 26. (c) 27. (a) 28. (b)
29. (a) P – Pulmonary semilunar valve
 Q – Aortic semilunar valve
 R – Opening of superior vena cava
 S – Pulmonary aorta

T – Inferior vena cava

U – Ascending aorta

- (b) Pulmonary semilunar valve (P) lies between pulmonary artery and right ventricle. It allows unidirectional flow of deoxygenated blood from right ventricle to pulmonary artery. Aortic semilunar valve (Q) lies between aorta and left ventricle. It allows unidirectional flow of oxygenated blood from left ventricle to aorta.
- (c) U (ascending aorta) carries oxygenated blood from left ventricle to body parts, whereas S (pulmonary aorta) carries deoxygenated blood from right ventricle to lungs and T (inferior vena cava) carries deoxygenated blood from lower body parts to right atrium.
30. (a) A - Thromboplastin B - Platelet factor - 3
- (b) Enzyme prothrombinase is formed by the combination of factor A and B with Ca^{2+} ions.
- (c) D is fibrinogen. Fibrinogen is a plasma protein that undergoes polymerisation to form insoluble polymer called fibrin that results in clot formation.

CHAPTER-19 : EXCRETORY PRODUCTS AND THEIR ELIMINATION

1. (a) 2. (d) 3. (d) 4. (d) 5. (d)
6. (c) 7. (d) 8. (a) 9. (c) 10. (a)
11. (a) 12. (a) 13. (c) 14. (b) 15. (b)
16. A-(ii), B-(i), C-(v), D-(iv), E-(iii)
17. A-(iii), B-(iv, viii), C-(i, v, vi), D-(ii, vii)
18. (A) (i) afferent arterioles (ii) Bowman's capsule
(iii) efferent arteriole (iv) portal system
(v) juxtaglomerular cells (vi) renin
(vii) angiotensinogen (viii) angiotensin
(ix) aldosterone (x) sodium ions
- (B) As blood pressure decreases, the cells of the juxtaglomerular apparatus releases the enzyme ~~Atrial Natriuretic Factor~~ renin. It converts ~~angiotensin-I~~ angiotensinogen into ~~angiotensinogen~~ angiotensin I. ~~Renin~~ Angiotensin converting enzyme then converts ~~angiotensinogen~~ angiotensin I into angiotensin II. ~~Angiotensin-I~~ Angiotensin II increases the synthesis and release of aldosterone,

~~decreases~~ raises blood pressure by ~~dilating~~ constricting blood vessels and stimulates sodium reabsorption by PCT.

19. (a) 20. (b) 21. (b) 22. (a) 23. (d)
24. (c) 25. (b) 26. (c) 27. (a) 28. (b)
29. (a) A – Afferent arteriole
B – Efferent arteriole
C – Bowman's capsule
D – Proximal convoluted tubule
- (b) The given figure is of Malpighian corpuscle. Malpighian corpuscle is the site of ultrafiltration (filtration under pressure). It is the first step in urine formation, which is carried out by the glomerulus. Hence, it is also known as glomerular filtration. The pressure of the blood flowing in the glomerular capillaries is higher than the pressure of the filtrate in Bowman's capsule. The blood pressure gradient, thus, created causes filtration of blood through three layers, *i.e.*, the endothelium of glomerular blood vessels, the epithelium of Bowman's capsule and a basement membrane between these two layers. The epithelial cells of Bowman's capsule are arranged in an intricate manner having minute spaces called filtration slits or slit pores. The glomerular capillaries are semi-permeable, thus, water and many dissolved substances except protein from the blood are filtered into the lumen of the Bowman's capsule through its walls.
30. (a) In the given figure, P, Q, R and S refer to juxtaglomerular apparatus, renin, aldosterone and afferent arteriole respectively.
- (b) Juxtaglomerular apparatus consist of juxtaglomerular cells and macula densa. Juxtaglomerular cells secrete renin. Renin converts angiotensinogen (present in the blood) into angiotensin. The latter increases blood pressure. Angiotensin also stimulates the secretion of aldosterone by the adrenal cortex, thus influencing the reabsorption of sodium ions by the distal convoluted tubule and that of water through the collecting duct.



CABINET APPROVES SETTING UP OF 75 GOVT MEDICAL COLLEGES, MOVE TO ADD OVER 15,000 MBBS SEATS

The Cabinet Committee on Economic Affairs (CCEA) approved on 28th August 2019 setting up of 75 government medical colleges, to be attached with existing district or referral hospitals, by 2021-2022.

The establishment of these medical colleges will add at least 15,700 MBBS seats in the country. The medical colleges will be set up in under-served areas having no such institutes. These medical colleges will be attached with district hospitals having at least 200 beds, a government statement said. Preference will be given to 'aspirational districts' and district hospitals having 300 beds, it said. The proposal is part of the phase III of a centrally sponsored scheme for establishment of new medical colleges by upgrading district or referral hospitals. The medical colleges would be set up at an estimated cost of Rs 24,375 crore. The establishment of new medical colleges, to be attached with existing district and referral hospitals, would lead to an increase in the availability of qualified health professionals, improve tertiary care in the government sector, utilise the existing infrastructure of district hospitals and promote affordable medical education in the country, the statement said.

"The scheme on the establishment of new medical colleges would lead to the addition of at least 15,700 MBBS seats in the country," it said. Continuing the focus on the creation of healthcare infrastructure, the government had earlier approved the establishment of 58 medical colleges to be attached with existing district and referral hospitals under phase I of the scheme and 24 institutes under the second phase. Of the 58 medical colleges approved under the first phase of the scheme, 39 have already started functioning and the rest would be made operational by 2020-2021.



CBSE

warm-up!

CLASS-XI

Chapterwise Practice questions for CBSE Exams as per the latest pattern and marking scheme issued by CBSE for the academic session 2019-20.

GENERAL INSTRUCTIONS

- There are a total of 27 questions and four sections in the question paper. All questions are compulsory.
- Section A contains question numbers 1 to 5, very short-answer type questions of 1 mark each.
- Section B contains question numbers 6 to 12, short-answer type I questions of 2 marks each.
- Section C contains question numbers 13 to 24, short-answer type II questions of 3 marks each.
- Section D contains question numbers 25 to 27, long-answer type questions of 5 marks each.
- There is no overall choice in the question paper, however, an internal choice is provided in two questions of 1 mark, two questions of 2 marks, four questions of 3 marks and all the three questions of 5 marks. In these questions, an examinee is to attempt any one of the two given alternatives.

Wherever necessary, the diagram drawn should be neat and properly labelled.

UNIT - III

- Cell - The Basic Unit of Life
- Biomolecules
- Cell Cycle and Cell Division

Time Allowed : 3 hours

Maximum Marks : 70

SECTION - A

- What is apoplasm?
- Define isozymes.
- Which protein helps in reuniting the separated chromatid segments during pachytene?

OR

What is the function of GLUT-4?

- Name the three parts of bacterial flagellum.

OR

What is coenocyte or syncytium?

- Name the protein that helps in the folding and transportation of newly synthesised proteins.

SECTION - B

- Ram found a new species of bacterium and is eager to know whether the bacterium is Gram +ve or Gram -ve. Which

test should he perform? Name an organism whose cell wall contain long chain of fatty acids called mycolic acids.

- How reducing sugars are different from non-reducing sugars?
- Which phase of cell cycle is best to study the number and morphology of chromosomes? Also write one characteristic feature of this phase.

OR

What are leucoplasts? What are the different types of leucoplasts?

- Classify the proteins on the basis of their shape.
- What is the significance of nucleoplasmic index?

OR

Write down any two fundamental features of cell theory.

- Define essential amino acids along with two examples.
- What is crossing over? When does it occurs?

SECTION - C

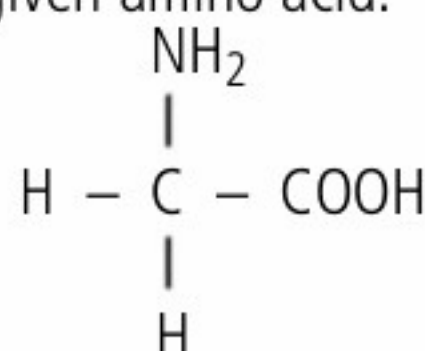
13. What is Michaelis Menten constant? How does the substrate concentration affect the velocity of the enzyme reaction?
14. (a) List any three differences between anaphase of mitosis and anaphase-I of meiosis.
- (b) Name the phase of meiosis in which:
- the amount of DNA is reduced to haploid state.
 - the chromosome number is reduced to haploid state.

OR

Write short notes on:

- (a) Protein specificity
- (b) PUFA

15. (a) Identify the given amino acid.



- (b) Differentiate between lyases and ligases.
- (c) What is turn over number? Given below are two enzymes A and B. Which one of these will be more efficient?

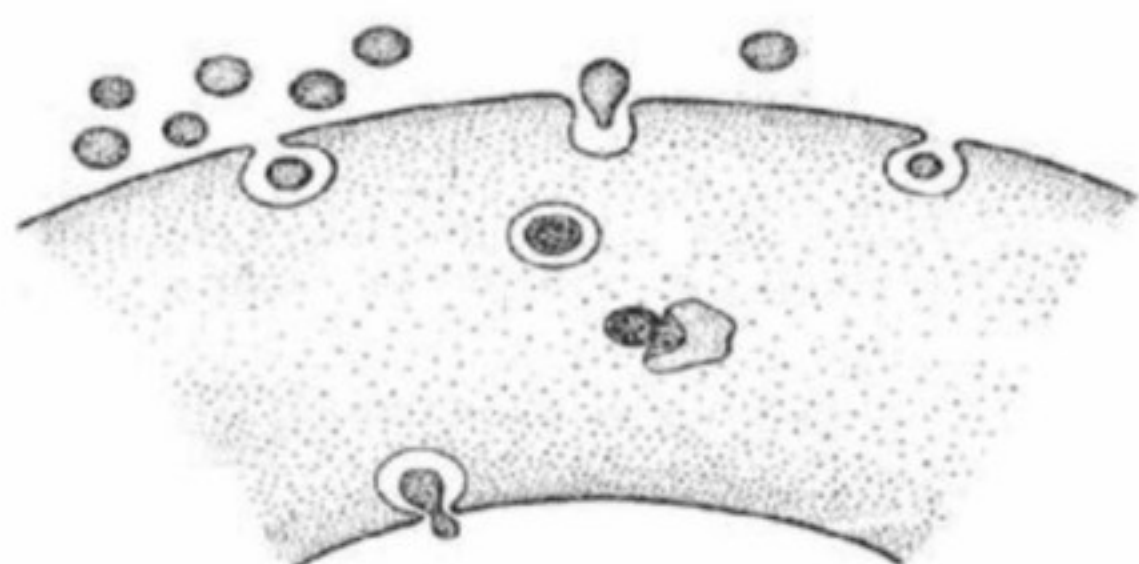
	K_{cat}	K_m
Enzyme A	low	high
Enzyme B	high	low

OR

A cell organelle X was found to be involved in autophagy. Identify the organelle X and give its important functions.

16. (a) Write significance of meiosis.
- (b) Give two examples of mitogen and mitotic poison each.
- (c) Name the stage of cell cycle during which pairing between homologous chromosomes take place.
17. Describe the following:
- (a) Synapsis
- (b) Synaptonemal complex
- (c) Chiasmata

OR



- (a) Identify and briefly describe the process shown in the figure.
- (b) How does this process differ from phagocytosis? (List any four differences).

18. In a biology laboratory, Rohit was provided with two

permanent slides. One slide was that of bacteria and another was of fungi. His teacher instructed that when they will observe these slides under the microscope, they will find a lot of difference between these two. Can you list few differences.

19. Explain the action of competitive inhibition. Mention the significance of competitive inhibition. Give an example of a competitive inhibitor.
20. "Meiosis II is not mitosis". Why?
21. Write the functions of the following:
- (a) Centriole
- (b) Cell wall
- (c) Mesosome
22. What changes occur in the nucleus of cell during prophase of mitosis?
23. Answer the following questions regarding nucleic acids:
- (a) Name the sugar found in DNA and RNA.
- (b) What is denaturation of DNA?
- (c) Discuss the types of DNA found in eukaryotic and prokaryotic cells.

OR

Differentiate between smooth endoplasmic reticulum (SER) and rough endoplasmic reticulum (RER).

24. What is the role of mitogens in cell division? Give examples of few mitogens.

SECTION - D

25. Describe lock and key hypothesis of enzyme action. Also give evidences in its favour.

OR

Describe the fluid mosaic model of plasma membrane with the help of labelled diagram.

26. List the functions of cilia and flagella. Also write down the differences between them.

OR

Define cell cycle. Explain the events that takes place during interphase with the help of diagram.

27. With reference to primary and secondary metabolites, answer the following questions:

- (a) Explain primary and secondary metabolites.
- (b) Name any three secondary metabolites.
- (c) Secondary metabolites have accessory rather than primary function in plants. Comment.
- (d) What is concanavalin A?

OR

What are the various stages of meiotic prophase I? Discuss with illustration.

SOLUTIONS

1. The non-living component of plant's body formed by cell wall and intercellular spaces is called apoplasm.
2. Isozymes or isoenzymes are the multiple molecular forms of an enzyme occurring in same organism and having a similar substrate activity.
3. R-protein re-unites the separated chromatid segments and the process is called re-annealing.

OR

GLUT-4 is a protein that enables glucose transport into cells.

4. Three parts of bacterial flagellum are filament, hook and basal body.

OR

Sometimes cytokinesis does not follow karyokinesis, instead it produces multinucleate condition, known as coenocyte or syncytium.

5. Chaperones
6. He should perform Gram staining test. Bacteria which retain blue colour with Gram stain even after washing is Gram (+ve) bacteria and which do not retain stain are Gram (–ve). *Mycobacterium* contains long chain fatty acids called mycolic acids.

7. Differences between reducing and non-reducing sugars are:

	Reducing sugars	Non-reducing sugars
(i)	The sugars have a free aldehyde (—CHO) or ketonic (—CO) group.	A free aldehyde or ketonic group is absent.
(ii)	The sugars can reduce cupric ions of Benedict's or Fehling's solution to cuprous ions.	They do not reduce cupric ions of Benedict's or Fehling's solution to cuprous ions.

8. Metaphase is the best phase to study the number and morphology of chromosome.
During metaphase, the centromeres of all the chromosomes lie on the equator while the limbs are placed variously according to their size and spatial arrangement and thus form an apparent plate called metaphasic or equatorial plate.

OR

Leucoplasts are colourless plastids which occur near nucleus in non-green cells and possess internal lamellae. They take part in storage of various substances and are of 3 types:

- (i) Aleuroplasts store proteins, *e.g.*, maize.
- (ii) Elaioplasts store lipids or fats, *e.g.*, tube rose.
- (iii) Amyloplasts store starch, *e.g.*, potato tubers, wheat grains.

9. On the basis of shape, proteins can be classified into two categories; fibrous and globular.

Fibrous proteins - They are thread like proteins which may occur singly or in groups. They are tough, non-enzymatic and structural proteins. Fibrous proteins generally possess secondary structure. *E.g.*, keratin of skin and hair.

Globular proteins - They are rounded in outline and lacks contractibility. Globular proteins may be enzymatic or non-enzymatic and possess tertiary or quaternary structure. *E.g.*, egg albumin, serum globulin.

10. The ratio of nuclear volume to cytoplasmic volume in a resting cell is known as nucleoplasmic index. This index regulates cell division after the cell has reached a particular size and it also helps in maintaining ratio between the nucleus and the cytoplasm.

OR

The two fundamental features of the cell theory are:

- (i) All living organisms are composed of cells and their products.
- (ii) Each cell is made of a small mass of protoplasm containing a nucleus in its inside and a plasma membrane with or without a cell wall on its outside.

11. Essential amino acids are those amino acids which the human body cannot synthesise from raw materials and are obtained from dietary proteins, *e.g.*, leucine and valine.

12. Process of exchange of genetic material or chromatid segments between non-sister chromatids of homologous chromosomes is known as crossing over.
It occurs during pachytene stage of prophase I of meiosis I after synapsis between homologous chromosomes.

13. Michaelis Constant (Michaelis Menten Constant, K_m) is mathematical derivation or constant which indicates the substrate concentration at which the chemical reaction catalysed by an enzyme attains half its maximum velocity. K_m indicates affinity of the enzyme for its substrate. A high K_m indicates low affinity while a low K_m shows strong affinity. If an enzyme acts on more than one substrate it shows different K_m values for them.

Increase in substrate concentration increases the rate of reaction. The enhanced rate is due to two factors: (i) occupation of more and more active sites by the substrate molecules; (ii) higher number of collisions between substrate molecules. The rise in velocity is quite high in the beginning but it decreases progressively with the increase in substrate concentration. If a graph is plotted for substrate concentration *versus* reaction velocity, it appears as a hyperbolic curve. A stage is reached where velocity is maximum. It does not increase further by increasing the substrate concentration. At this stage the enzyme molecules become fully saturated and no active site is left free to bind additional substrate. This saturation effect is shown by all enzymes.

14. (a) Differences between mitotic anaphase and meiotic anaphase - I are:

	Mitotic anaphase	Meiotic anaphase - I
(i)	A centromere splits length-wise to form two centromeres in the beginning of anaphase.	Centromeres do not divide during anaphase I but do so in anaphase II.
(ii)	Anaphasic chromosomes are single stranded.	Chromosomes are double stranded in anaphase I but single stranded in anaphase II.
(iii)	Similar chromosomes move towards the opposite poles in anaphase.	Dissimilar chromosomes move towards the opposite poles both in anaphase I and anaphase II.

- (b) (i) Anaphase - II
(ii) Anaphase - I

OR

- (a) Protein specificity – Every cell has hundreds of different proteins. Each kind of cell has some proteins unique to itself, and these proteins make it distinct from all other types of cells. Every species likewise has a set of proteins found in no other species. Similar species share many of their proteins, whereas dissimilar species share fewer. Study of proteins, thus, shows the evolutionary relationship among species.

The principle of protein specificity has practical application in blood transfusion, tissue grafting and organ transplants which succeed only in animals that have similar proteins.

- (b) PUFA – PUFA or polyunsaturated fatty acids are fatty acids which have more than one double bond. PUFA is recommended for persons suffering from cardiovascular disorder, high blood cholesterol, hypertension. PUFA lower the blood cholesterol. *E.g.*, oils like safflower and sunflower.

15. (a) Glycine

- (b) The differences between lyases and ligases are as follows :

	Lyases	Ligases
(i)	They cause cleavage of specific covalent bonds.	They build up covalent bonds.
(ii)	There is no hydrolysis.	Water is often released or used up in reactions catalysed by ligases.

- (c) The number of substrate molecules changed per minute by a molecule or enzyme is called turn over number (k_{cat}). The higher the turn-over number, the more efficient an enzyme is. Enzyme B has high turn-over number (k_{cat}) and low K_m . A low K_m shows strong affinity of the enzyme for its substrates. Therefore, enzyme B is more efficient enzyme.

OR

An organelle X is lysosome.

The important functions of lysosomes are as follows:

- Intracellular digestion – Individual cells may obtain food through phagocytosis. The same is digested with the help of lysosomes.
 - Extracellular digestion – For this the lysosomes release enzymes in the external environment through exocytosis.
 - Body defence – Lysosomes of leucocytes devour foreign proteins, toxic substances, bacteria and other microorganisms. They thus take part in natural defence of the body.
 - Removal of obstructions – Obstructing structures are destroyed by lysosomes.
 - Mobilisation of reserves – During periods of starvation, lysosomes provide nourishment by rapidly hydrolysing the organic foods stored in the cells (carbohydrates, fats and proteins).
 - Intracellular scavenging – In long lived cells the lysosomes perform intracellular scavenging by removing old or useless organelles.
- 16 (a) Meiosis is essential for formation of gametes and maintenance of chromosome number in sexually reproducing organisms. Gametes produced by meiosis have half the number of chromosomes.
- (b) Mitogen – Cytokinin, Lymphokines
Mitotic poison – Colchicine, Cyanides
- (c) Zygotene of prophase I of meiosis I.
17. Synapsis: During zygotene of prophase I stage, homologous chromosomes start pairing together and this process of association is called synapsis. Electron micrographs of this stage indicate that chromosome synapsis is accompanied by the formation of complex structure called synaptonemal complex.
- Synaptonemal complex: This complex is a tripartite, ribbon-like structure, and is situated between paired homologous chromosomes. It consists of a dense central element, with a dense lateral elements on either side. Each lateral element is attached on the inner side of a homologous chromosome. The space between the central and lateral elements is traversed by a series of transverse units of LC fibres (L for lateral and C for central), which connects the two. The synaptonemal complex is attached at both ends through its lateral elements to the inner surface of the nuclear membrane.
- Chiasmata: The beginning of diplotene is recognized by the dissolution of the synaptonemal complex and the tendency of the synapsed homologous chromosomes of the bivalents to separate from each other except at the sites of crossovers.

These points of attachment (X-shaped structures) between the homologous chromosomes are called chiasmata.

OR

- (a) The given figure shows the process of pinocytosis. Pinocytosis is the bulk transport of fluid matter and substances dissolved in it (e.g., ions, sugars, amino acids) across the cell membrane by forming minute detachable vesicles of 100–200 nm. Selective solute intake occurs through specific pits having receptor sites. As soon as solute or ligand particles form complexes with receptor sites, plasma membrane invaginates. The invagination deepens and gets pinched off as a vesicle called pinosome (Lewis, 1931). The pinosome migrates towards the interior where it liberates the materials either in the cytoplasm or a vacuole.

- (b) Differences between pinocytosis and phagocytosis are:

	Pinocytosis	Phagocytosis
(i)	It is the bulk intake of fluid materials by a cell.	Phagocytosis is the intake of solid material from outside to the inside of the cell.
(ii)	Vesicles formed in pinocytosis are small.	Vesicles formed in phagocytosis are large.
(iii)	Membrane possesses receptor pits for receiving the materials.	Receptor pits are absent.
(iv)	Membrane does not show evagination during pinocytosis.	Membrane evaginates on the periphery to engulf the solid particle.

18. Differences between bacteria and fungi are:

	Bacteria	Fungi
(i)	A prokaryotic cell with one envelope organisation.	A eukaryotic cell with two envelope organisation.
(ii)	Flagella, if present, are single stranded and without differentiation of axoneme and sheath.	Flagella, if present, are 11-stranded with differentiation of axoneme and sheath.
(iii)	An organised nucleus is absent. Instead a nucleoid is found.	An organised nucleus is found. It is differentiated into nuclear envelope, chromatin, one or more nucleoli and nucleoplasm.
(iv)	Ribosomes are of 70S type.	Ribosomes are of 80S type. 70S ribosomes however, occur in plastids and mitochondria.

(v)	Membrane bound organelles like ER, mitochondria, Golgi apparatus, centrioles, lysosomes and other microbodies are absent.	Mitochondria, ER, Golgi apparatus and microbodies including lysosomes, centrioles are present in cells of organisms in which motile stage is present in the life cycle.
(vi)	Cell wall, if present, possesses muramic acid.	Cell wall, if present, without muramic acid.

19. Competitive inhibition is the inhibition of enzyme activity by the presence of a chemical that competes with the substrate for binding to the active site of the enzyme. The inhibitor chemical is called substrate analogue or competitive inhibitor. It resembles the substrate in structure and gets bound up to the active site of the enzyme without getting transformed by the latter. As a result, the enzyme cannot participate in catalytic change of the substrate. This is similar to the jamming of a lock by a key similar to original one. The significance of competitive inhibition : (i) It gives evidence for lock and key hypothesis of enzyme action. (ii) Substrate analogues are not metabolised by enzymes. (iii) Control of bacterial pathogens has been affected through competitive inhibition. Example; reduction of activity of succinate dehydrogenase by malonate, oxaloacetate and other anions which resemble succinate in their structure.
20. Meiosis II is shorter than the typical mitotic division because of the shortening of prophase of this division. The division maintains the number of chromosomes produced at the end of reduction division. It is hence called homotypic or equational division. Though it is similar to mitosis, meiosis II is not mitosis because :

What² it?



Send your response at editor@mtg.in or post to us with complete address by 10th of every month. Winners' name will be published in next issue.

- (i) It always occurs in haploid cells.
- (ii) It is not preceded by DNA replication.
- (iii) The two chromatids of a chromosome are often dissimilar.
- (iv) The daughter cells formed after meiosis II are neither similar to each other nor similar to the parent cell.

The main function of homotypic division or meiosis II is to separate the chromatids of univalent chromosomes which differ from each other in their linkage groups due to crossing over.

- 21. (a)** Centrioles occur in nearly all animal cells and in motile plant cells such as zoospores of algae, sperm cells of ferns, etc. They are capable of replication. They can transform into basal body which give rise to cilia and flagella. They organise spindle fibres and astral rays during cell division.
- (b)** Cell wall - Cell wall helps in providing a definite shape to the cell and also protects protoplasm against any mechanical injury, *i.e.*, damage and infection. It also helps in cell-to-cell interaction and provides barrier to undesirable macromolecules and attack of pathogens.
- (c)** Mesosome : It is formed by extension of plasma membrane in a prokaryotic cell, it helps in cell wall formation, DNA replication and respiration.
- 22.** Prophase is studied in three substages-early, middle and late. In early prophase, the nucleus becomes spheroidal. Viscosity of cytoplasm increases. The indistinct and intertwined DNA molecules condense to form elongated chromosomes. Therefore, the chromatin reticulum disappears. The chromosomes appear like a ball of wool. It is also called spireme stage. In early prophase, chromosomes are evenly distributed inside nucleus. In middle prophase, they shift towards the periphery or nuclear envelope so as to leave a clear central area. Simultaneously the chromosomes shorten and thicken further to assume characteristic shape and size. The size of chromosomes is reduced to some $1/25^{\text{th}}$ of their size in early prophase. Shortening of chromosomes is a must for their equitable distribution later during anaphase. Each chromosome appears to consist of two longitudinal threads called chromatids. The two chromatids, also called sister chromatids, are attached to each other by means of a narrow point called centromere. Nucleolus or nucleoli are found attached to one or more chromosomes. They however, appear smaller as compared to those of interphase nucleus. In late prophase fine fibres start appearing around the nucleus. The nucleolus or nucleoli degenerate completely. By this time the two asters come to lie in the area of future spindle poles. Spindle poles are organised without asters in plant cells. The two spindle poles begin to get connected by fine fibres.
- 23. (a)** DNA - Deoxyribose sugar
RNA - Ribose sugar
- (b)** The hydrogen bonds between the nitrogen bases of complementary DNA strands can break due to high

temperature, low or high pH. This phenomenon is called denaturation or melting. Since an A-T base pair has only two hydrogen bonds, the area rich in A-T base pairs can undergo easy denaturation. It is known as low melting area. The area rich in G-C base pair is comparatively more stable because three hydrogen bonds connect the complementary nitrogen bases.

- (c)** DNA molecules are of 2 types: linear and circular. Linear DNA is found in the nuclei of eukaryotic cells. It is associated with proteins in about 1 : 1 ratio. Circular DNA is found in many viruses, all prokaryotic cells, and in the mitochondria and chloroplasts (plastids) of eukaryotic cells. It is associated with very little protein.

OR

The differences between SER and RER are as follows:

	SER	RER
(i)	It does not bear ribosomes over the surface of its membrane.	It possess ribosomes attached to its membrane.
(ii)	Its main function is synthesis of lipids.	Its main function is synthesis of proteins.
(iii)	Formed of vesicles and tubules.	Formed of cisternae and few tubules.
(iv)	It is usually found in periphery.	It is found deep inside the cytoplasm.
(v)	It may develop from RER.	It may develop from nuclear envelope.

- 24.** Mitogens are agents, factors or substances that trigger cell division. The common plant mitogen is the hormone cytokinin. There are several mitogenic substances known in human beings, *e.g.*, lymphokines, EGF (Epidermal Growth Factor), PDGF (Platelet Derived Growth Factor).
- 25.** Lock and key hypothesis was put forward by Emil Fischer in 1894. According to this hypothesis, both enzyme and substrate molecules have specific geometrical shapes. In the region of active sites the surface configuration of the enzyme is such as to allow the particular substrate molecules to be held over it. The active sites also contain special groups having —NH_2 , —COOH , —SH for establishing contact with the substrate molecules. The contact causes the substrate molecules or reactants to come together leading to the chemical change. It is similar to the system of lock and key. Just as a lock can be opened by its specific key, a substrate molecule can be acted upon only by a particular enzyme. This also explains the specificity of enzyme action. After coming in contact with the active site of the enzyme, the substrate molecules or reactants form a complex called enzyme-substrate complex. In the complexed state the molecules of the substrate undergo chemical change. The

products remain attached to the enzyme for some time so that an enzyme-product complex is also formed. However, the products are soon released and the freed enzyme is able to bind more substrate molecules.

Enzyme + Substrate $\rightleftharpoons$ Enzyme – Substrate Complex

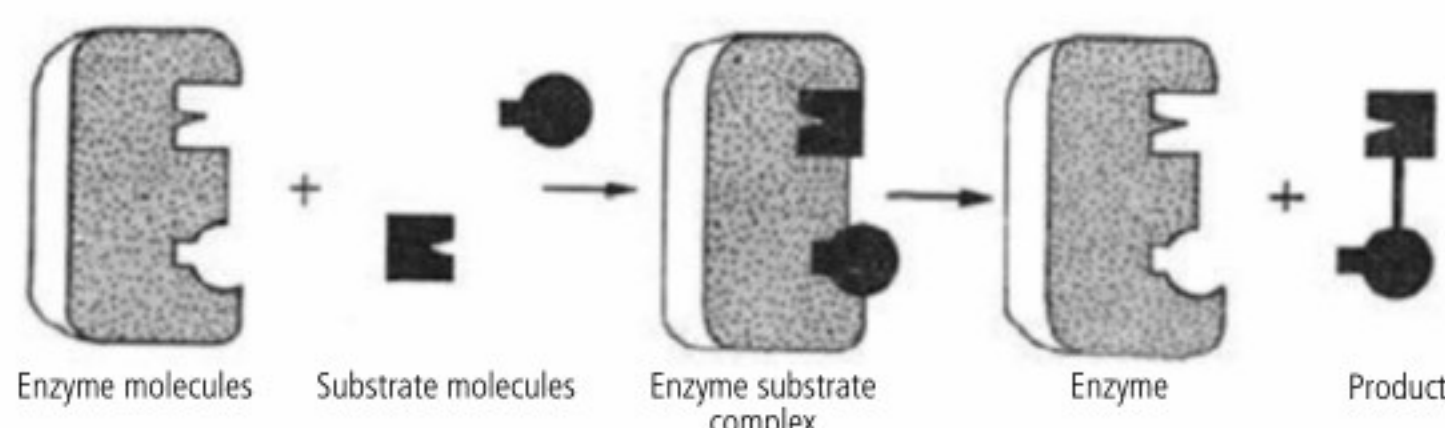
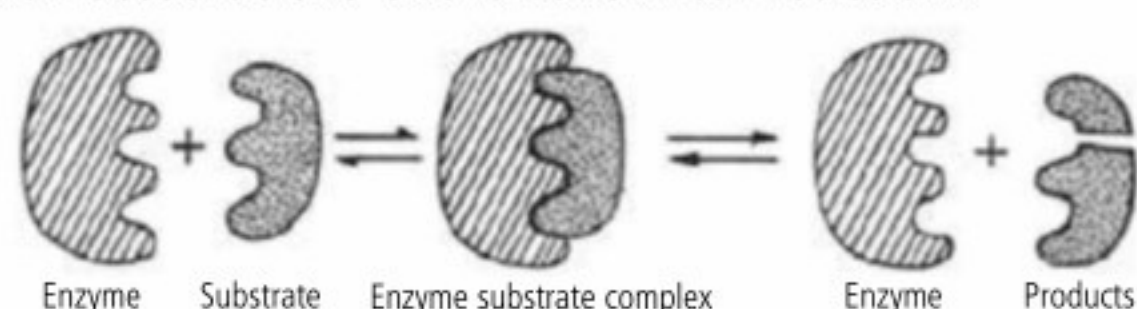
Enzyme – Substrate Complex $\rightleftharpoons$ Enzyme – Products Complex

Enzyme – Products Complex $\rightleftharpoons$ Enzyme + Products

The chemical reactants do not cause any alternation in the composition or physiology of enzyme. The same enzyme molecules can be used again. Hence, enzymes are required in very small concentration.

Following evidences are in support of this hypothesis:

- (i) Blow and Steitz (1970) found the formation of complex between the enzyme chymotrypsin and its substrate.
- (ii) Keilen and Maun observed that the absorption spectra of the same enzyme are different in the free state and in the presence of the substrate.
- (iii) The theory explains how a small concentration of enzyme can act upon a large amount of the substrate.
- (iv) Lock and key theory explains how the enzyme remains unaffected at the end of chemical reaction.



- (v) It is able to predict the increase in the rate of chemical reaction on the addition of more enzyme or substrate.
- (vi) The theory explains how a substance having a structure similar to the substrate can work as competitive inhibitor.

OR

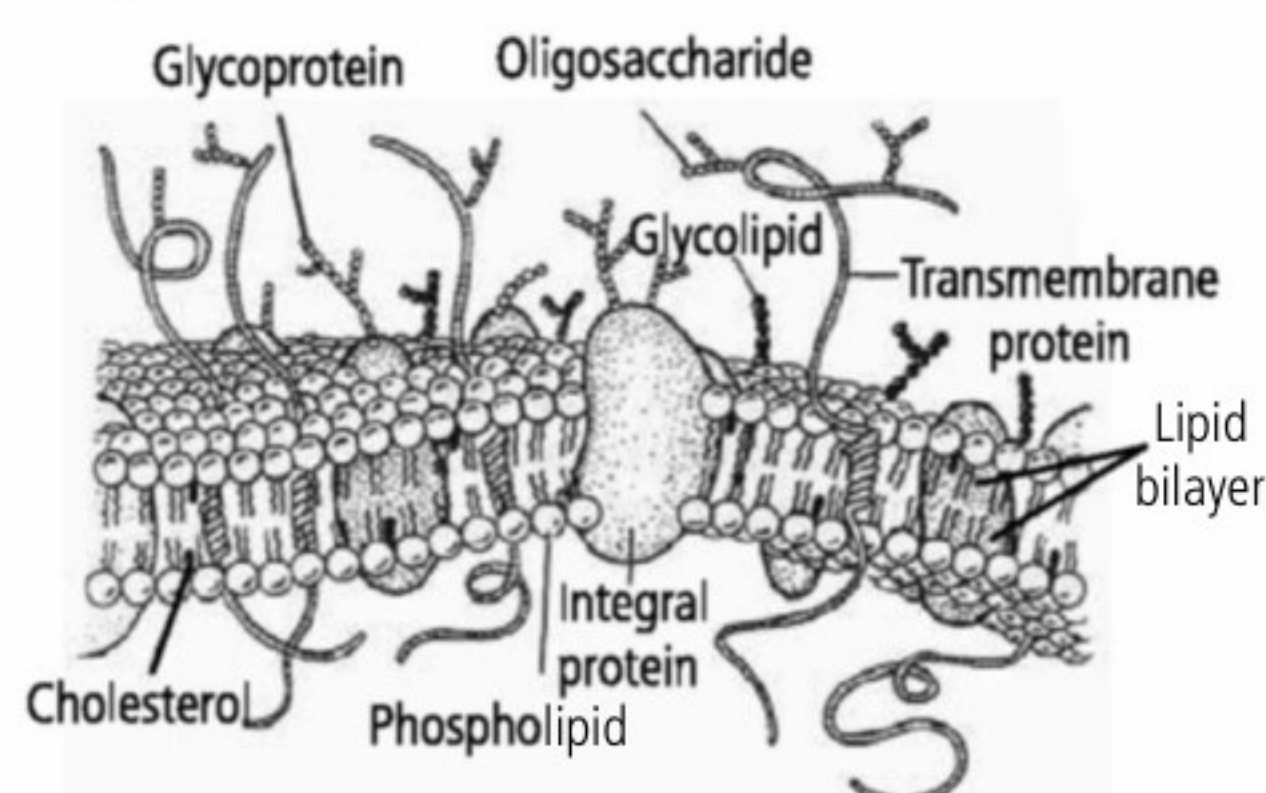
Fluid mosaic model of lipid membrane was proposed by Singer and Nicolson in 1972. According to this model, the membrane does not have a uniform deposition of lipids and proteins but is instead a mosaic of the two. Further, the membrane is not solid but is quasifluid. This nature is responsible for properties like repair, dynamic nature, ability to fuse, endocytosis, etc.

The main lipid components of the plasma membrane are phospholipids, cholesterol and galactolipids; their proportion varies in different cell membranes. According to fluid-mosaic model, lipid molecules are present in viscous bilayer and protein molecules occur at places both inside and on outer side of the lipid bilayer. Intrinsic or integral proteins represent more than 70% of the total membrane proteins. They are insoluble in water solutions,

are associated with lipids. They attach to oligosaccharides to form glycoproteins. They pass into the lipid bilayer to different depths and establish hydrophobic bonds with lipid molecules. Some of the integral proteins run throughout the lipid bilayer.

The extrinsic or peripheral proteins are superficially on the two surfaces of the membrane, more on the cytosolic face than on the external face. Peripheral proteins are separated by mild treatment with high ionic strength or with metal chelating agents.

Fluid mosaic model of a membrane having glycocalyx or carbohydrates attached to outer proteins and lipids are as follows:



26. Functions of cilia and flagella are as follows:

- (i) They help in locomotion in flagellate and ciliated organisms.
- (ii) They create current for obtaining food from aquatic medium.
- (iii) The canal system of porifers operates with the help of flagella present in their collar cells or choanocytes.
- (iv) In coelenterates, they circulate food in the gastro-vascular cavity. In tunicates and lancelets, the cilia help in movement of food and its egestion.
- (v) In aquatic organisms cilia create currents in water for renewal of oxygen supply and quick diffusion of carbon dioxide.
- (vi) In land animals the cilia of the respiratory tract help in eliminating dust particles in the incoming air and perform internal transport of several organs, e.g., passage of eggs in oviduct, passage of excretory substances in the kidneys, etc.

Monthly Test Drive-5 CLASS XI ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (b) | 2. (a) | 3. (b) | 4. (b) | 5. (b) |
| 6. (a) | 7. (d) | 8. (b) | 9. (d) | 10. (b) |
| 11. (c) | 12. (c) | 13. (b) | 14. (b) | 15. (a) |
| 16. (a) | 17. (d) | 18. (c) | 19. (a) | 20. (c) |
| 21. (d) | 22. (a) | 23. (b) | 24. (d) | 25. (c) |
| 26. (b) | 27. (a) | 28. (c) | 29. (c) | 30. (d) |
| 31. (a) | 32. (b) | 33. (a) | 34. (a) | 35. (d) |
| 36. (b) | 37. (b) | 38. (b) | 39. (c) | 40. (b) |

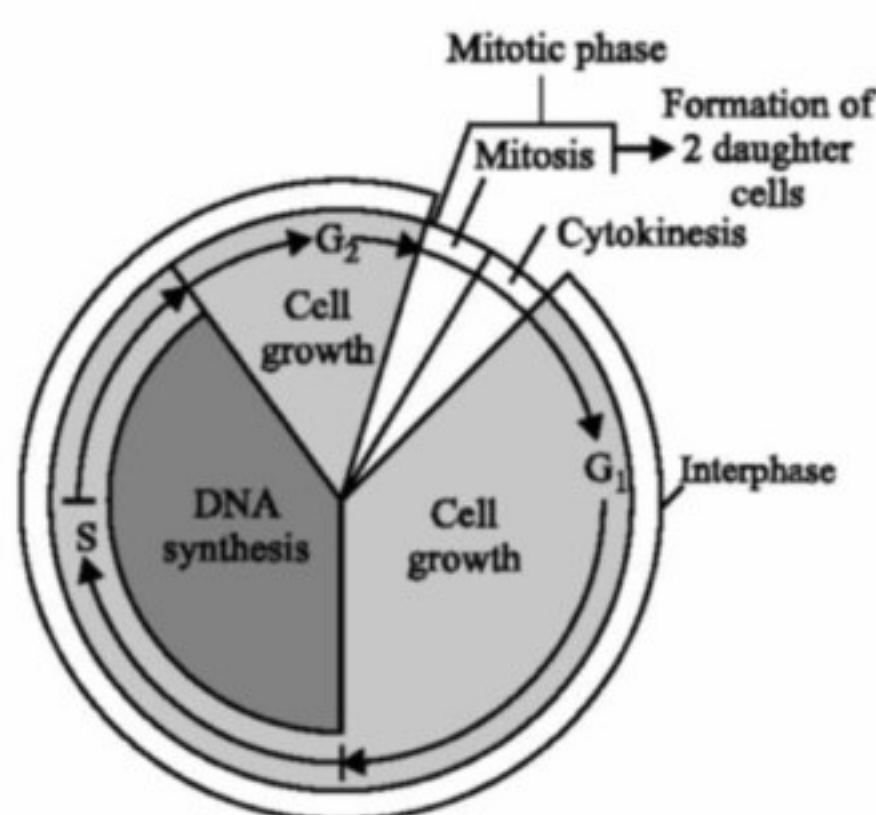
The differences between cilia and flagella are as follows :

	Cilia	Flagella
(i)	The number of cilia per cell is usually very large (300 - 14000).	The number of flagella per cell is usually 1 - 4.
(ii)	They are smaller (5-20 μm in length).	They are longer (100-200 μm in length).
(iii)	Cilia usually occur throughout or major part of the surface of a cell.	Flagella are commonly found at one end of the cell.
(iv)	They beat in a co-ordinated rhythm either simultaneously (isochronic or synchronous rhythm) or one after the other (metachronic rhythm).	The flagella beat independently.
(v)	Cilia produce a sweeping or pendular stroke.	The flagella produce undulatory motion.
(vi)	Cilia help in locomotion, aeration, feeding circulation, etc.	Flagella help in locomotion.
(vii)	Cilia may fuse to form undulating membrane.	Fusion of flagella is unknown.

OR

Cell cycle is genetically controlled series of changes that occur in newly formed cell by which it duplicates its genome, synthesises other constituents, undergoes growth and divides to form two daughter cells.

Interphase is a series of changes that take place in a newly formed cell and its nucleus before it becomes capable of division again. Diagrammatic representation of nucleus at interphase is as follows:



It is divided into three periods : First gap or G_1 phase, synthetic or S-phase and second gap or G_2 phase.

- (i) G_1 phase : This follows M-phase and is characterised by the synthesis of RNA and proteins. Cell growth occurs and energy rich compounds are formed. Cell organelles also increase in number. It has a deciding point called check point, G_1 cyclin or C_{G_1} which control transition of G_1 to next phase called S phase.
- (ii) S phase : This follows the G_1 phase. It is characterised by replication of DNA and synthesis of histone proteins. New chromatin fibres are formed which remain attached in pairs and the number of chromosomes does not increase. Centrosome also begins to divide in centriole containing cells to form centriole pair.
- (iii) G_2 phase : In this phase, the cell prepares for next cell division. It is characterised by the initiation of mitotic spindle, formation and synthesis of factors necessary for condensation of chromosome. The cell contains double the amount of DNA as compared to original diploid cell.

27. (a) Primary metabolites - These are directly involved in the normal growth, development and reproduction of an organisms. *e.g.*, proteins, carbohydrates, fats, etc.

Secondary metabolites - These are not directly involved in physiological processes but many are useful for human welfare. *e.g.*, drugs, alkaloids, etc.

(b) Some secondary metabolites are : Pigments (carotenoids), alkaloids (morphine), essential oils (lemon grass oil), etc.

(c) Many plants, fungi and microbes of certain genera and families synthesise a number of organic compounds which are not involved in primary metabolism *e.g.*, photosynthesis, respiration, protein and lipid metabolism and seem to have no direct function in growth and development of plants. Such compounds are secondary metabolites. These compounds are accessory rather than central to the functioning of the plants in which they are found. These are derivatives of primary metabolites.

(d) Concanavalin A is a mannose/glucose binding lectin and is a secondary metabolite.

OR

Prophase I is the first stage of meiosis I. It is considered to be the most complicated and prolonged phase as compared to the similar stage in mitosis. It is further sub-divided into five sub-stages on the basis of chromosomal behavior, *i.e.*, leptotene, zygotene, pachytene, diplotene and diakinesis.

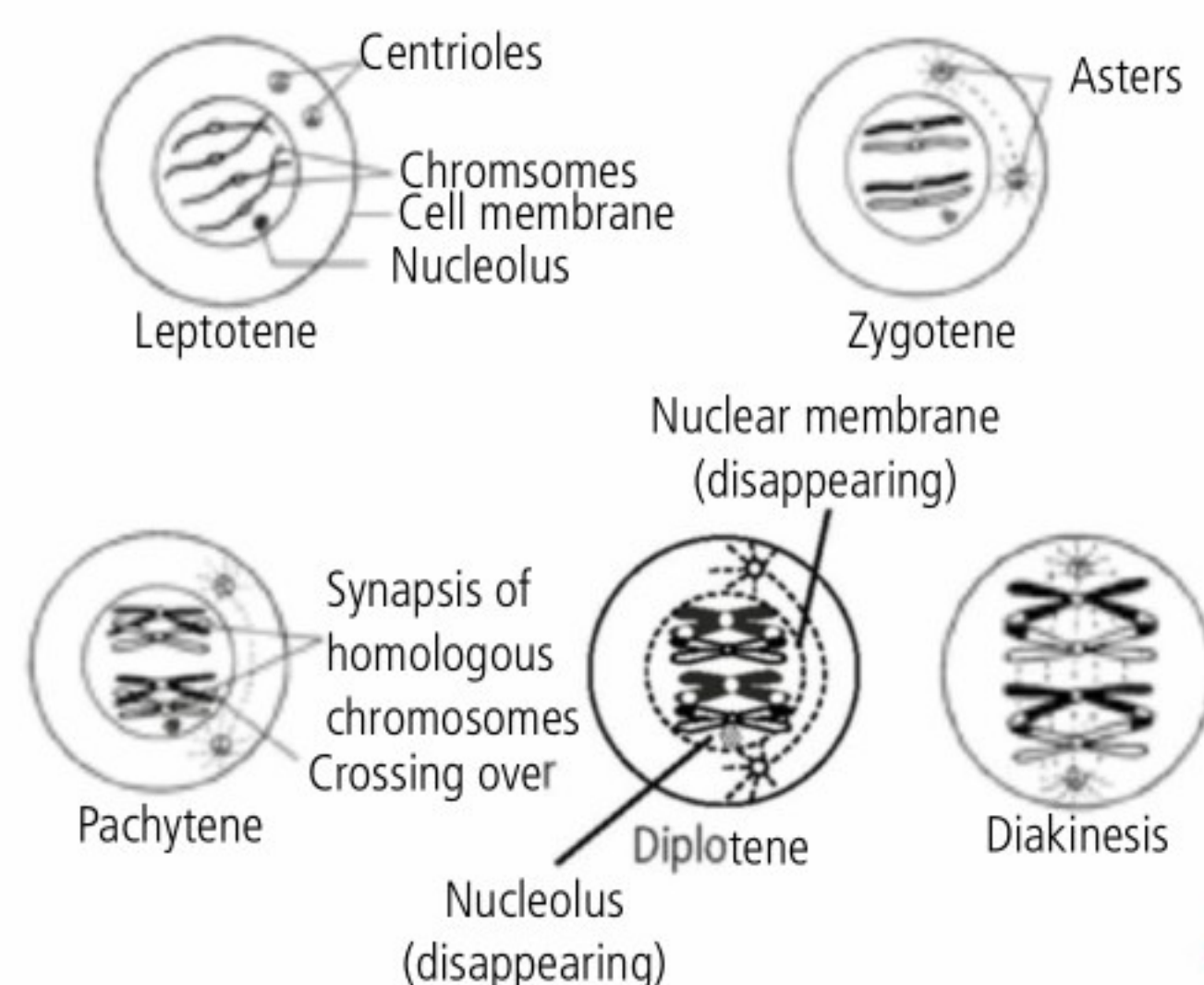
- (i) Leptotene: It is known to be the very first stage of meiotic division following the interphase. During this stage chromosomes become gradually visible under light microscope, centrioles start moving towards opposite poles and each centriole develops astral rays. Each chromosome is attached to the nuclear envelope

through the attachment plate at both of its ends.

- (ii) Zygotene: This is the next sub-stage that takes place after the completion of the leptotene. In this stage homologous chromosomes pair up. This pairing is done in such a way that the genes of the same character present on the two chromosomes lie exactly opposite to each other. This process of association is known as synapsis. Formation of synaptonemal complex takes place by a pair of homologous chromosomes that show synapsis. The complex so formed, on account of synapsis forms a bivalent or a tetrad.
- (iii) Pachytene: It is the stage which immediately follows zygotene where the pair of chromosomes become twisted spirally around each other and cannot be distinguished separately. Bivalent chromosomes are clearly seen as tetrads. In this stage, sometimes exchange of genes or crossing over between the two non-sister chromatids of homologous chromosomes occurs at the points called recombination nodules, which appear at intervals on synaptonemal complex. By the end of pachytene, recombination gets completed leaving the chromosomes linked at the sites of crossing over.
- (iv) Diplotene: It is the stage of longest duration of all. In this stage, the synaptonemal complex appears to get dissolve while, the chromatids of each tetrad

remain clearly visible. Recombined homologous chromosomes of the bivalents get separated and form chiasmata (X-shaped structures). Chiasmata formation is necessary for the separation of homologous chromosome which have undergone the process of crossing over.

- (v) Diakinesis: This is known to be the final stage of meiotic prophase I. Also known as terminalisation, due to the shifting of chiasmata towards the end of the chromosomes. Chromosomes become fully condensed, nucleolus degenerates, nuclear envelope breaks down into vesicles and there is formation of meiotic spindle (as in mitosis) of the homologous chromosomes.



UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I

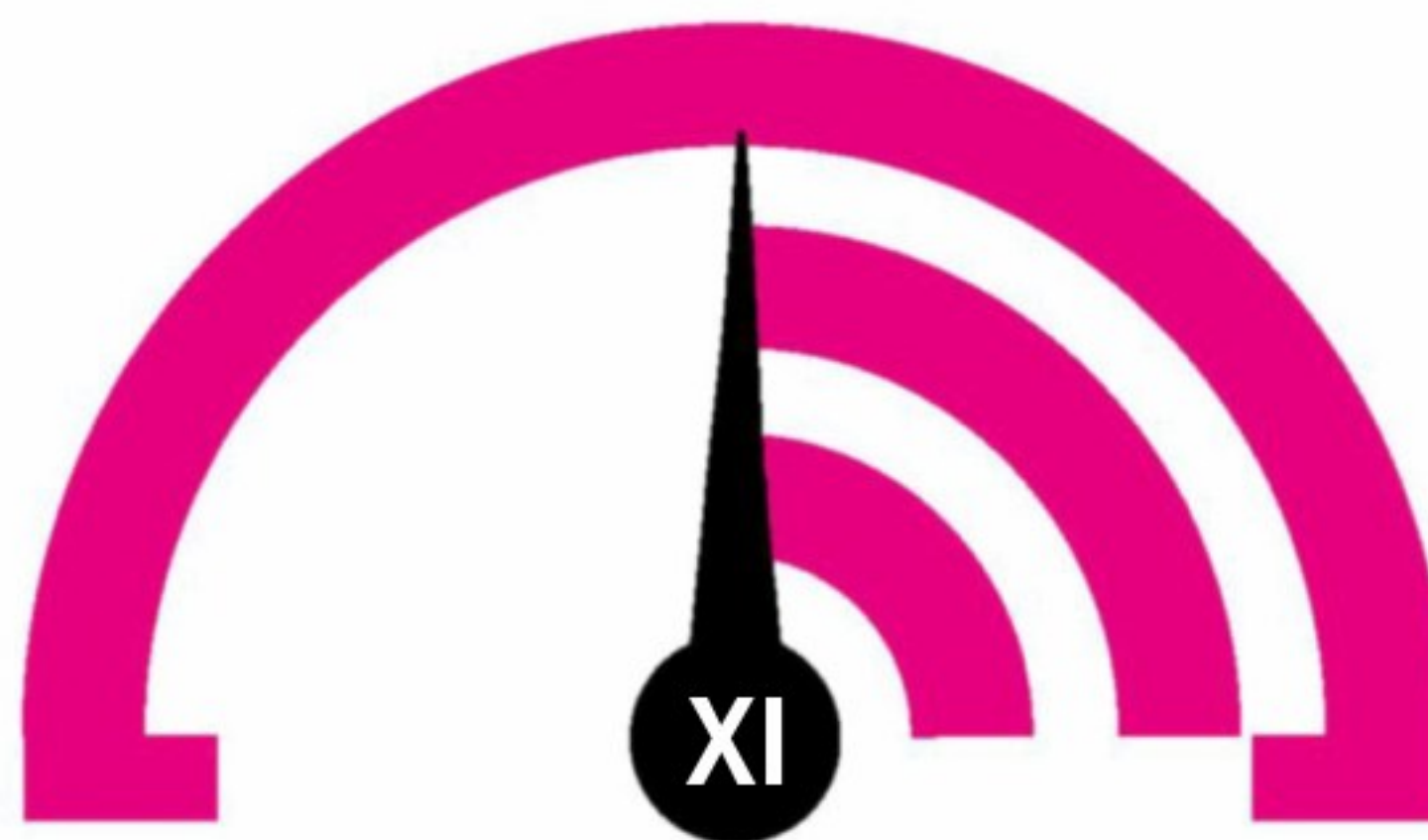
1. RTOXIPHMCOI
2. NIPERSAIMTO
3. SEAPCASS
4. ITLCESENL
5. OPETRMOR
6. DRCSOOPHYIN
7. MUNFDBIULUNI
8. MBLASIIN
9. SAHHDYDEOT
10. OENTND

Column II

- (a) Hereditary lack of pigmentation in an organism.
- (b) It is a narrow, hollow stalk that connects the hypothalamus to the pituitary gland.
- (c) Growing of plants in a mineral nutrient solution in complete absence of soil.
- (d) Mode of nutrition shown by *Euglena*.
- (e) A thick strand or sheet of tissue which attaches a muscle to a bone.
- (f) Protease enzymes that initiate and carry out cascade of events during apoptosis.
- (g) Aerating pores in the bark of plants.
- (h) Specialised pores along the apex of the leaf through which guttation takes place.
- (i) Release of mature spermatids from Sertoli cells into seminiferous tubules, lumen prior to their passage to the epididymis.
- (j) Binding site of DNA for RNA polymerase.

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month. Winners' names will be published in next issue.

MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 160

Series 5: • Biomolecules • Cell Cycle and Cell Division

Time Taken : 40 Min.

1. Meiosis consists of
- two cell divisions without any DNA replication
 - two cell divisions in which chromosome number is reduced to half
 - two cell divisions with only two rounds of chromosome replication
 - a single cell division with chromosome replication.

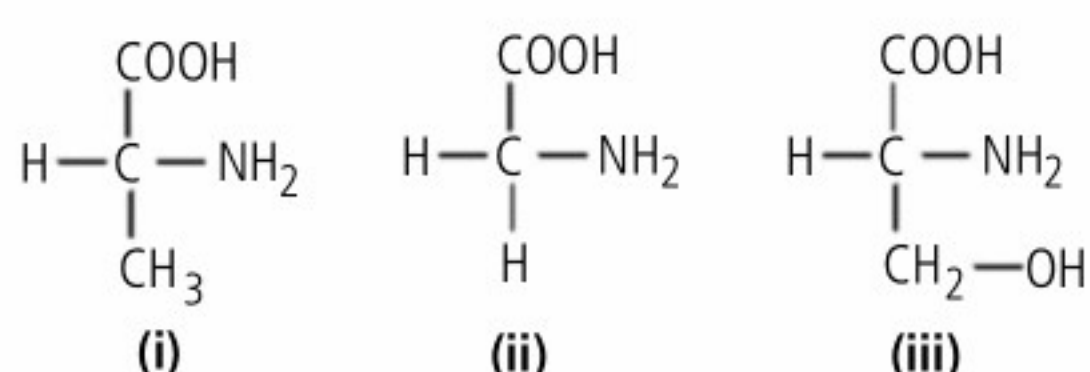
2. Select the correct match.

- | | | |
|-----------------|----------------|--------------------------------|
| (A) S phase | – | DNA replication |
| (B) Zygotene | – | Synapsis |
| (C) Diplotene | – | Crossing over |
| (D) Meiosis | – | Both haploid and diploid cells |
| (E) Gap-2 phase | – | Quiescent stage |
| (a) A and B | (b) C and D | |
| (c) C and E | (d) A, C and E | |

3. Which of the following events are not characteristic features of telophase?

- Chromosome material condenses to form compact mitotic chromosomes.
 - Nucleolus, Golgi complex and ER reform.
 - Nuclear envelope assembles around the chromosome clusters.
 - Centromeres split and chromatids separate.
 - Chromosomes cluster at opposite, spindle poles and their identity as discrete elements is lost.
- A, B and D only
 - A and D only
 - B and C only
 - C, D and E only

4. Identify the amino acids given below and select the correct option.



- | | (i) | (ii) | (iii) |
|-----|---------|---------|---------|
| (a) | Glycine | Serine | Alanine |
| (b) | Alanine | Glycine | Serine |
| (c) | Alanine | Serine | Glycine |
| (d) | Serine | Alanine | Glycine |

5. Catalytic cycle of enzyme can be described by the following step.

- Substrate binds to the active site of the enzyme.
- Active site of the enzyme breaks the chemical bond of the substrate forming a new enzyme–product complex.
- Shape of the enzyme is altered due to binding of the substrate.
- Product of the reaction is released.

What is the correct sequence of enzyme action?

- 1 → 2 → 3 → 4
- 1 → 3 → 2 → 4
- 2 → 1 → 3 → 4
- 2 → 3 → 1 → 4

6. Match column I with column II and select the correct option from the codes given below.

Column I (Category)	Column II (Secondary metabolites)
A. Pigments	(i) Concanavalin A
B. Terpenoides	(ii) Monoterpenes, diterpenes
C. Alkaloids	(iii) Morphine, codeine
D. Lectins	(iv) Carotenoids, anthocyanins
(a) A-(iv), B-(ii), C-(iii), D-(i)	(b) A-(iv), B-(iii), C-(ii), D-(i)
(c) A-(i), B-(iv), C-(iii), D-(ii)	(d) A-(i), B-(iii), C-(ii), D-(iv)

7. Cellulose, the most important constituent of plant cell wall is made up of

- branched chain of glucose molecules linked by a α , 1, 6 glycosidic bond at the site of branching
- unbranched chain of glucose molecules linked by α , 1, 4 glycosidic bond
- branched chain of glucose molecules linked by β , 1, 4 glycosidic bond in straight chain and α , 1, 6 glycosidic bond at the site of branching
- unbranched chain of glucose molecules linked by β , 1, 4 glycosidic bond.

8. If a cell contains 36 chromosomes, what will be the number of chromosomes in each of the 4 daughter cells resulting from meiosis?

(a) 36 (b) 18
(c) 9 (d) none of these

9. During meiosis I, the bivalent chromosomes clearly appear as tetrads during

(a) diakinesis (b) diplotene
(c) leptotene (d) pachytene.

10. A stage of mitosis is shown in the diagram. Which stage is it and what are its characteristics?



- (a) Metaphase - Spindle fibers attached to kinetochores, centromeres split and chromatids separate.
(b) Metaphase - Chromosomes arranged at spindle equator, chromosomes made up of two sister chromatids.
(c) Anaphase - Centromeres split and chromatids separate and start moving away.
(d) Late prophase - Chromosomes move to spindle equator.

11. Colchicine is a cell poison which arrests cell division at _____ and can induce _____.

(a) metaphase, parthenocarp
(b) anaphase, parthenocarp
(c) metaphase, polyploidy (d) anaphase, polyploidy

12. Inulin is used in assessing GFR (Glomerular Filtration Rate) because

(a) it is a polysaccharide of high molecular weight
(b) it is insoluble and stored in roots
(c) it is a polysaccharide of low molecular weight and remain unutilised in human body
(d) it is a low molecular weight compound, which do not interfere in the functioning of kidney.

13. The correct order of chemical composition of living tissues/cells in term of percentage of the total cellular mass is

(a) Nucleic acid > Proteins > H_2O > Carbohydrates > Ions > Lipids
(b) H_2O > Proteins > Nucleic acid > Carbohydrates > Lipids > Ions
(c) H_2O > Proteins > Carbohydrates > Nucleic acid > Lipids > Ions
(d) Lipids > Ions > Carbohydrates > H_2O > Proteins > Nucleic acid

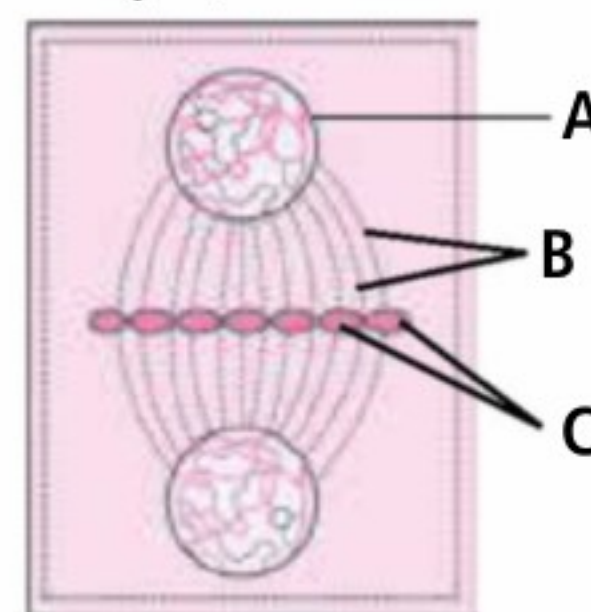
14. Which of the following is a typical example of feed back inhibition?

(a) Sulpha drugs and folic acid synthesiser bacteria
(b) Allosteric inhibition of hexokinase by glucose 6-phosphate
(c) Reaction between succinic dehydrogenase and succinic acid
(d) Cyanide and cytochrome reaction

15. The enzyme recombinase is required at which stage of meiosis?

(a) Pachytene (b) Zygotene
(c) Diplotene (d) Diakinesis

16. The given diagram depicts cell plate method of cytokinesis in plant cells. Identify A, B and C.



A **B** **C**

(a) Daughter nucleus Phragmoplast Vesicles
(b) Daughter nucleus Vesicles Phragmoplast
(c) Parent nucleus Vesicles Phragmoplast
(d) Parent nucleus Phragmoplast Vesicles

17. Identify the mitotic stage from the given features.

(i) Nuclear envelope degenerates
(ii) Endoplasmic reticulum and Golgi complex disorganise.
(iii) Fully formed spindle apparatus, consists of fine fibres.
(a) Middle prophase (b) Telophase
(c) Anaphase (d) Prometaphase

18. Which statement is correct for enzymes?

(i) Enzymes of Kreb's cycle are endoenzymes.
(ii) Apoenzymes are easily separable non protein part of holoenzyme.
(iii) Conversion of glucose-6-phosphate to fructose-6-phosphate is catalysed by enzyme isomerase.
(iv) Theoretically all enzyme catalysed reactions are reversible.
(a) (i) and (iii) (b) (ii) and (iv)
(c) (i), (iii) and (iv) (d) (i), (ii) and (iv)

19. Formation of brick red colour on adding Benedict's solution to food sample indicates the presence of

IMPORTANT DAYS IN OCTOBER

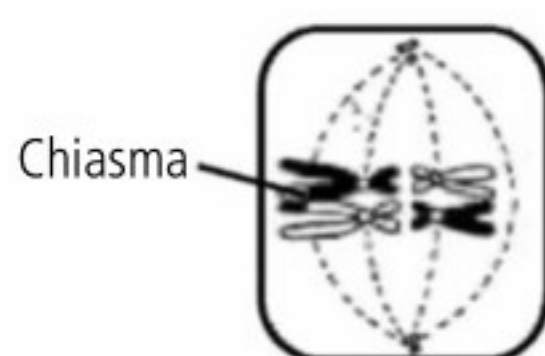
October 2 : Gandhi Jayanthi,
International Day of Non-violence
October 4 : World Animal Day
October 5 : World Teachers' Day
October 7 : World Habitat Day (1st Monday)
October 8 : Indian Air Force Day
October 10 : World Mental Health Day
October 11 : National Girl Child Day
October 15 : World Students Day
October 16 : World Food Day
October 24 : United Nations Day
October 30 : World Thrift Day

- (a) reducing sugar lactose
- (b) non-reducing sugar sucrose
- (c) homopolysaccharide fructan.
- (d) heteropolysaccharide agar.

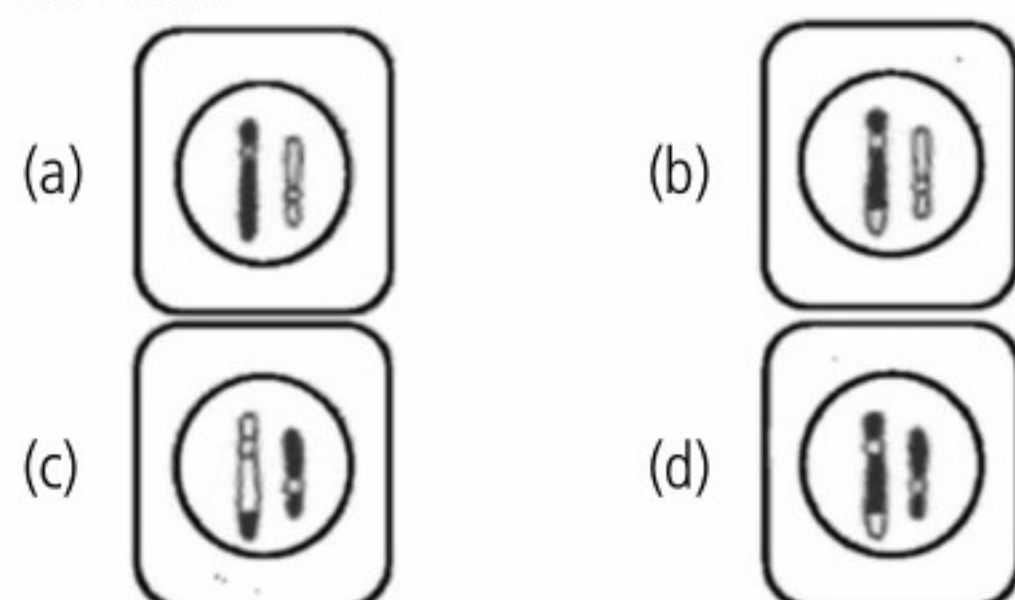
20. Identify the incorrectly matched pair.

- (a) Ferritin - storage protein
- (b) Tyrosine - aromatic amino acid
- (c) Stearic acid - unsaturated fatty acid
- (d) Vinblastin - alkaloid

21. Consider the given cell at metaphase-I stage undergoing normal meiosis.



Which of the following gametes will not be formed from this cell?



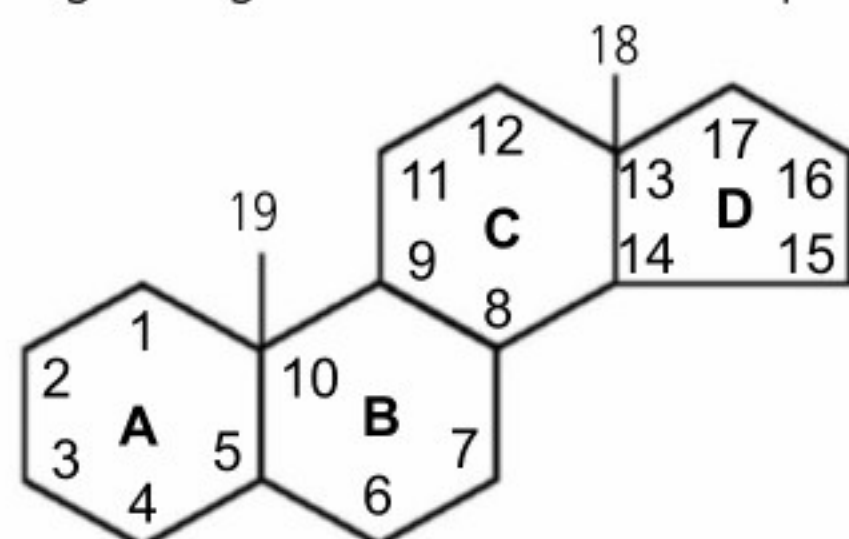
22. Which of the following statements is incorrect about G_0 phase?

- (a) Mitosis occurs after G_0 phase.
- (b) Cell can exit G_0 phase and join cell cycle anytime
- (c) it occurs due to non availability of energy and mitogens.
- (d) Cell metabolism occurs continuously in G_0 phase.

23. Enzyme that helps in union of separated chromatid segments during meiosis is

- (a) A-protein
- (b) R-protein
- (c) T-protein
- (d) U-protein.

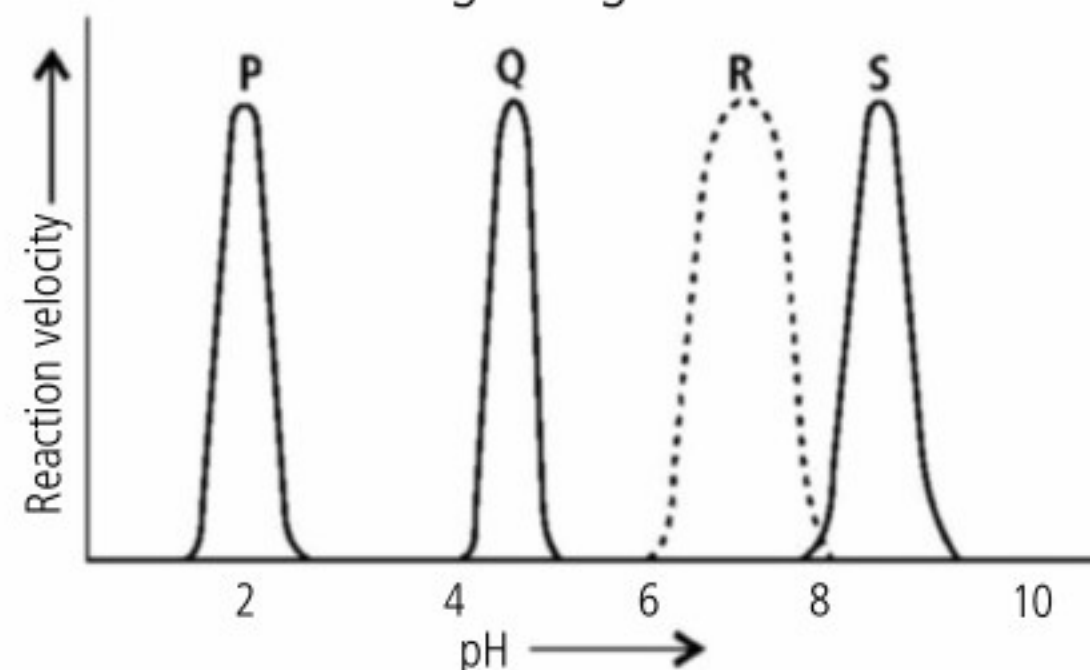
24. Identify the given figure and select correct option regarding it.



It could be

- (a) lipoprotein and is found in blood, milk and egg yolk
- (b) prostaglandin which is a derivative of arachidonic acid and helps in cell communication and vasodilation
- (c) terpene which is formed of isoprene
- (d) steroid and is found in hormones like estrogen and progesterone.

25. Refer to the given graph showing relation between pH and activity of four enzymes. Identify P, Q, R and S and select incorrect statement regarding them.



- (a) P could be found in stomach and helps in digestion of proteins.
- (b) Q could be found in intestinal juice and helps in digestion of carbohydrates.
- (c) R could be found in oral cavity and is responsible for digestion of 60% of starch.
- (d) S could be found in pancreatic juice and helps in activation of a proenzyme.

26. Read to the given pair of differences between primary and secondary metabolites and select the incorrect ones.

	Primary metabolites	Secondary metabolites
(i)	These are produced in generous quantities and can easily be extracted from the plant.	These are produced in small quantities and their extraction from the plant is difficult.
(ii)	They are found in one plant species or families and not all.	These are found throughout the plant kingdom.
(iii)	These are not part of the basic molecular structure of the cell.	These are part of the basic molecular structure of the cell.
(iv)	They have limited role in plant.	They are highly useful in plant.
(v)	They are found from the start of plant life.	They are found at particular stages of development.

- (a) (i) and (v)
- (b) (ii), (iii) and (iv)
- (c) (i), (iv) and (v)
- (d) (iv) and (v)

27. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into?

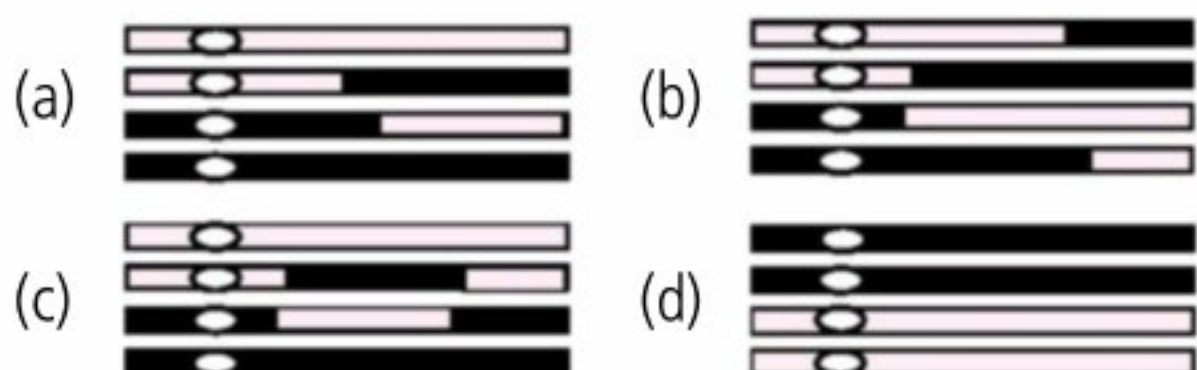
- (a) Metaphase
- (b) Telophase
- (c) Anaphase
- (d) Prophase

28. Refer to the given and Identify the given stages of mitosis and select the correct option.

	A	B	C	D
(a)	Prophase	Metaphase	Telophase	Anaphase
(b)	Metaphase	Anaphase	Prophase	Telophase

- (c) Anaphase Metaphase Prophase Telophase
(d) Prophase Metaphase Anaphase Telophase

29. Following figure is showing the chiasmata formed between the non-sister chromatids of homologous chromosomes during diplotene stage. Select the option correctly, showing the resultant recombinant chromosomes.



30. Which of the following factors does not regulate the occurrence of cell division?

- (a) Karyoplasmic ratio (b) Mitogen
(c) Cyclin C_M (d) Colchicine

31. Arrange the given sugars in the increasing order of their sweetening index.

- (a) Lactose < Maltose < Sucrose < Fructose < Saccharin
(b) Maltose < Lactose < Sucrose < Fructose < Saccharin
(c) Saccharin < Fructose < Sucrose < Maltose < Lactose
(d) Lactose < Maltose < Fructose < Sucrose < Saccharin

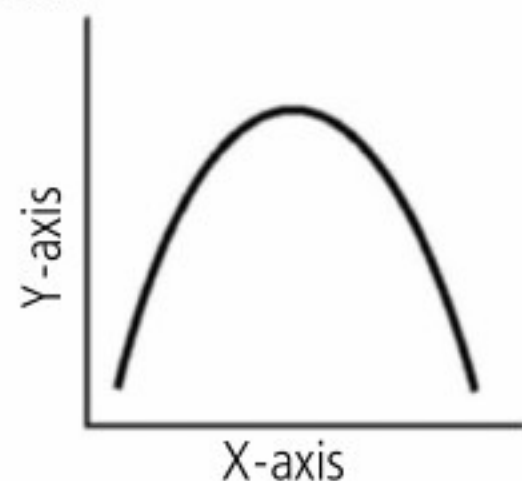
32. K_m value for enzyme is substrate concentration to produce

- (a) twice V_{max} (b) half V_{max}
(c) V_{max} (d) one fourth of V_{max}

33. Hexose and pentoses are the most common

- (a) monosaccharides (b) polysaccharides
(c) disaccharides (d) oligosaccharides.

34. Refer to the given graph. Select the option that correctly identifies X and Y axis.



X-axis

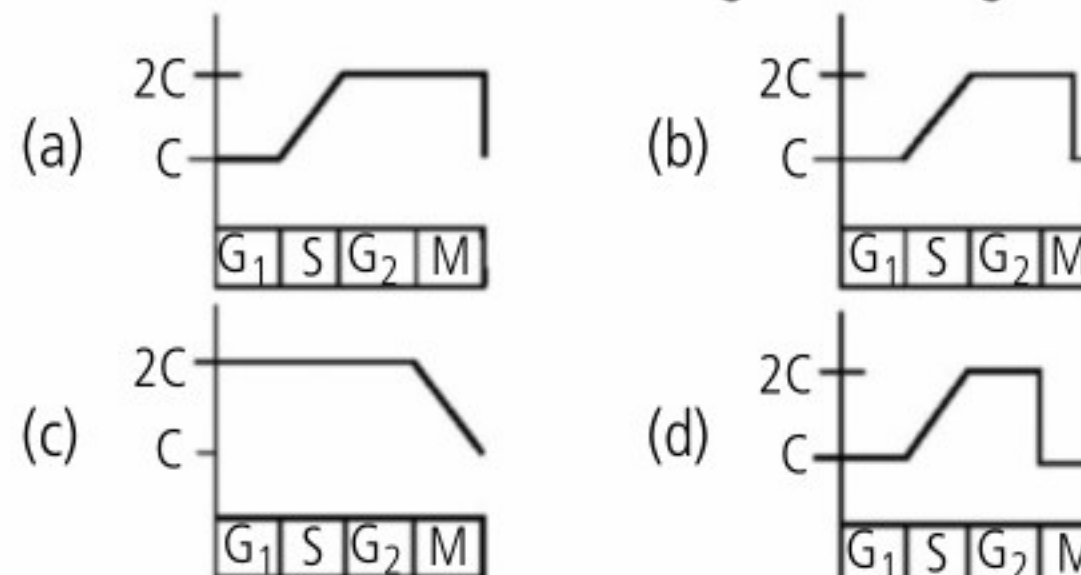
Y-axis

- (a) Temperature Enzyme activity
(b) Substrate concentration Enzymatic activity
(c) Enzymatic activity Temperature
(d) Enzymatic activity pH

35. Amitosis type of cell division occurs in

- (a) *Paramecium* (b) diseased cells
(c) *Chara* (d) all of these.

36. Identify the correct graph representing the amount of DNA in cell nucleus that had undergone through meiosis.



37. Read the given statement and select the option that correctly identifies X and Y.

In a glycogen molecule, successive glucose units are joined together by X and branches are linked together by Y.

X

Y

- (a) 1, 4- α -glycosidic bonds 1, 4- α -glycosidic acids
(b) 1, 4- α -glycosidic bonds 1, 6- α -glycosidic bonds
(c) 1, 6- α -glycosidic acids 1, 4- α -glycosidic acids
(d) 1, 6- α -glycosidic acids 1, 6- α -glycosidic acids

38. During an enzymatic reaction, K_m was calculated. The value of K_m came out to be 10^{-5} . It indicates

- (a) enzyme is deactivated.
(b) enzyme has high affinity for its substrate.
(c) enzyme has low affinity for its substrate.
(d) none of the above.

39. Trypsin is added to the baby food because

- A. It improves the texture of the product.
B. It stabilises the milk powder.
C. It helps in predigestion of the food.
D. It diminishing the risk of babies developing milk allergies.
Out the following which of the following are correct?
(a) B and C (b) B and D
(c) C and D (d) A and B

40. A coenocyte may form when

- (a) cytokinesis is immediately followed by karyokinesis
(b) cytokinesis does not follow karyokinesis
(c) karyokinesis does not follow cytokinesis
(d) both (b) and (c).



Key is published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted

No. of questions correct

Marks scored in percentage

Check your score! If your score is

- > 90% **EXCELLENT WORK !** You are well prepared to take the challenge of final exam.
90-75% **GOOD WORK !** You can score good in the final exam.
74-60% **SATISFACTORY !** You need to score more next time.
< 60% **NOT SATISFACTORY!** Revise thoroughly and strengthen your concepts.

CONCEPT MAP

ANIMAL HUSBANDRY

Animal husbandry is the farming or management of animal livestock which includes various aspects such as animal's shelter, feeding, breeding, health and disease control. In animal husbandry domesticated animals are reared for economic or for recreation purposes, e.g., cattle, buffalo, sheep, goat, etc. It also includes poultry, fisheries and bee keeping. Animal husbandry helps in augmenting the production of milk, meat, egg and other animal by-products.

Animal breeding

A specific group of animals related by descent and similar in most characters like general appearance, features, size, etc., is called '**breed**'. Animal breeding is producing improved breeds of domesticated animals by improving their genotypes through selective mating.

Farm management

Farm management is the controlled and scientific handling of farm animals for their rearing, grooming and breeding so as to maximise their yield.

- (i) **Dairy farm management** : It deals with processes and systems that increase the yield and improve quality of milk.
 - **Father of white revolution** in India is **Verghese Kurein**.
- (ii) **Poultry farm management** : It is rearing of domesticated fowls (chickens), ducks, geese, turkeys, guinea fowls and pigeons, etc.
 - Poultry birds exclusively grown for meat are called **broilers** (e.g., plymouth rock), **layers** are for egg production, **cockerels** are young male fowls and **roosters** are mature male fowls.

Fisheries

- **Fishery** is concerned with the catching, processing or selling of fish, shellfish (prawns and molluscs) or other aquatic animals such as crabs, lobster, edible oyster, etc.
- **Aquaculture** is rearing and management of useful aquatic plants and animals like fishes, oysters, mussels, prawns, etc.
- **Pisciculture** is rearing, catching and management of edible fishes.
- There are two main types of fisheries :
- (i) **Inland fishery** is the rearing of fish in freshwater. E.g., (*Palaemon*, *Macrobrachium*) and fish like *Labeo rohita* (rohu), *Labeo calbasu* (calbasu), *Catla catla* (catla), *Mystus seenghala* (catfish).
- (ii) **Marine fishery** deals with the fishery aspects of the sea water or ocean. E.g., *Hilsa* (hilsa), *Eleutheronema* (Indian salmon), *Sardinella* (sardine), *Pampus* (pomfret).
- **Blue revolution** is concerned with fish production in India.

Fishery



Fish



Crab



Prawns



Edible oyster

Bee-keeping

Apiculture or bee keeping is rearing and management of honey bees. Honey bees give us honey, pollen products and wax. They are also good pollinators.

- **Apiary** is the place where bees are cultured and bred to get commercial products.
- **Common species** of honey bees are – *Apis dorsata* (rock bee), *Apis indica* (Indian bee), *Apis florea* (little bee) and *Apis mellifera* (European bee).
- Three types of individuals (castes) are found in the colony of honey bees- (i) **Queen** is the only fertile female which lays eggs, (ii) **Drones** are fertile males which mate with queen. (iii) **Workers** are sterile females and perform various duties of the colony.
- **Beehives** or nests of honey bees are formed of a secretion from the wax glands of workers. It consists of **storage cells**, packed with honey and pollen and **brood cells**, where young ones are brought up.



Worker

Queen

Drone

Natural breeding

Natural breeding is a type of breeding that occurs naturally among animals. It is of two types :

- (i) **Inbreeding** : Inbreeding refers to the mating of more closely related individuals within the same breed for 4 - 6 generations. It increases **homozygosity**, so it is necessary for evolving a **pureline** in any animal. Continued inbreeding usually reduces fertility and even productivity. This condition is called **inbreeding depression**.
- (ii) **Outbreeding** : Outbreeding is the breeding of the unrelated animals which may be between individuals of the same breed but no common ancestors, or between different breeds or different species. It is of following three types :
 - (a) **Outcrossing** : It involves mating between unrelated members of the same breed which have no common ancestors on either sides of their pedigree upto 4 - 6 generations.
 - (b) **Cross breeding** : It is the method of breeding superior males of one breed with superior females of another breed. It allows the desirable qualities of two different breeds to be combined. E.g., **Hisardale** sheep.
 - (c) **Interspecific hybridisation** : Mating between members of two different species produces interspecific hybrids. It is performed only when the sterile hybrid is far superior to either of the parents. E.g., Mule.

Artificial breeding

Artificial breeding is a controlled breeding method which is carried out using **artificial insemination** and **Multiple Ovulation Embryo Transfer Technology (MOET)**.

- **Artificial insemination** : The semen is collected from the male that is chosen as a parent and injected into the reproductive tract of the selected female by the breeder. The semen may be used immediately or can be frozen and used at a later date. It helps to overcome several problems of normal matings.
- **MOET** : Cow is administered with hormones of FSH-like activity to induce follicular maturation and super ovulation. They produce 6-8 eggs instead of one egg (normal yield) per cycle. The animal is then either mated with an elite bull or artificially inseminated. The fertilised eggs in 8-32 cells stages, are recovered non-surgically and transferred to surrogate mothers.

Cattle

Cattle includes **cow** (adult female), **bull** (uncastrated adult male), **bullock** or **ox** (castrated adult male) and **steer** (young castrated male). The cattle breeds are classified into three groups:

- (i) **Milch breeds** : The cows of these breeds are good milk producers, however, bullocks are of poor quality. E.g., Gir, Sahiwal
- (ii) **Drought breeds** : The bullocks of these breeds are good for working but cows are poor milk producers. E.g., Malvi
- (iii) **General utility breeds (Dual-purpose breeds)** : The cows of these breeds are good milk producers and the bullocks are good drought animals. They are intermediate between milch and drought breeds. E.g., Ongole
- **Indian breeds** : Gir, Sahiwal, Red Sindhi, Nagori, Hallikar and Kankrej.
- **Exotic breeds** : Holstein - Friesian (Holland), Brown Swiss (Switzerland) and Jersey. These have been hybridised with Indian cows to develop locally acclimatised high performance cattle, e.g., Karan Swiss, Jersey-Sindhi, Brown Swiss-Sahiwal.



General utility breed



Milch breed



Exotic breed

Buffaloes

- The best known breeds of **Indian buffaloes** are the Murrah (Punjab, Haryana, U.P.), Jafarabadi (Gujarat), Nili (Punjab, Haryana), Bhadawari (U.P., M.P.), Surti (Gujarat, Rajasthan), Mehsana (Gujarat) and Nagpuri (Central and South India).



Indian breed

Sheep

- Deccani and Nellore breeds are raised only for mutton.
- The wool yielding breeds are Rampur - Bushari (long course wool), Lohi (good quality wool, milk), and Bakharwal (undercoat for shawls).
- **Exotic breeds** : Merino (Spain), Dorset horn (England) and Corriedale (New Zealand).



Merino

Goat

- **Common breeds of goats** : Malabari (Kerala), Berari (Maharashtra), Marwari (Rajasthan), Beetal (Punjab), Jamunapari (U.P., M.P.) and Kashmiri and Pashmina (Himachal Pradesh, Kashmir and Tibet).
- **Exotic breeds** : Alpine (Alps), Toggenburg and Saanen (Switzerland).



Jamunapari

Poultry

Breeds of fowls are –

- **Indigenous breeds** : Chittagong, Aseel, Bursa, Danki, etc.
- **American breeds** : Plymouth Rock, Wyandotte, Rhode Island Red, New Hampshire.
- **Asiatic breeds** : Brahma, Langshan, Cochin.
- **English breeds** : Sussex, Orpington, Australorp, Cornish, Dorking, Red Cap.
- **Mediterranean breeds** : Leghorn, Minorca, Ancona, Spanish, Andalusian and Buttercup.



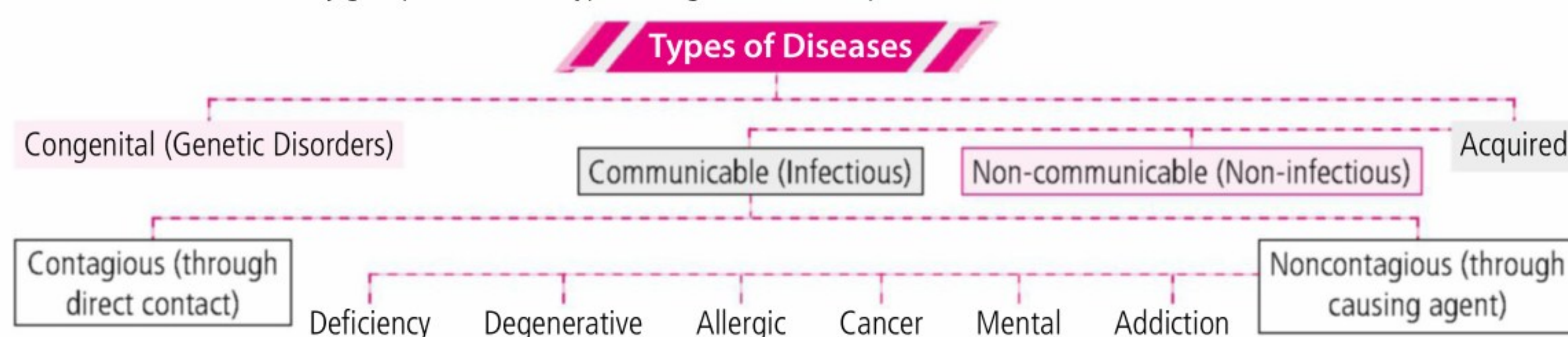
Plymouth rock

BIO Digest

This article covers high yield facts of the given topic.

Human Health and Disease

- **Health**, is a state of complete physical, mental and social well being. When the functioning of one or more organs of body is adversely affected, we say that we are not healthy, *i.e.*, we have a **disease**. In humans, "**disease**" is often used more broadly to refer to any condition that causes pain, dysfunction, distress, or death to the person afflicted.
- Disease involves morphological, physiological or psychological disturbance in some body parts. It may be due to some pathogens and vectors. A **symptom** is a sensation or change in health condition experienced by a patient, *e.g.*, fatigue, pain, nausea, etc.
- Diseases can be broadly grouped into two types: congenital and acquired.



CONGENITAL DISEASES

- A congenital disorder is a medical condition that is present at birth. It can be recognised before birth, at birth or many years later. These can be a result of genetic abnormalities, the intrauterine environment or unknown factors. *E.g.*, Down's syndrome, Edward syndrome, colour blindness, etc.

ACQUIRED DISEASES

- These are acquired during the lifetime of an individual and are not present from birth. These are caused by disease causing agents or due to the life style of an individual. These are of two types communicable disease and non communicable disease.

Communicable Diseases

- These diseases are caused by microorganisms such as bacteria, viruses, parasites, etc., that can spread directly or indirectly from one person to another.

Viral diseases

- Viruses cause influenza, common cold, yellow fever, polio, rabies, AIDS, etc.

Table : Some important viral diseases of humans

	Disease	Pathogen	Epidemiology
(i)	Hepatitis	Hepatitis virus	Fever, headache, gastrointestinal disturbances, dark urine, jaundice.
(ii)	AIDS (Acquired Immuno Deficiency Syndrome)	Human Immuno-deficiency Virus (HIV)	Fever, lethargy, nausea, headache, rashes, etc.
(iii)	Chicken pox	Varicella zoster	Mild fever, rashes, spread through contact with infected individuals.
(iv)	Herpes	Herpes simplex virus	Fever, blisters, spread through contact with infected saliva, exhibits latency - disease can be dormant for several years.
(v)	Measles	Rubeola virus	Reddish rash appears on the neck which spreads over body.
(vi)	SARS (Severe Acute Respiratory Syndrome)	Coronavirus	Spreads through patients secretions from nose, mouth and throat. Results in high fever, chills, dizziness, headache, sore throat.

Bacterial diseases

- Bacteria cause many diseases in humans, some diseases are dispersed through food or water, including typhoid fever, bacillary dysentery, etc.

Table : Some important bacterial diseases of humans

	Disease	Pathogen	Epidemiology
(i)	Diphtheria	<i>Corynebacterium diphtheriae</i>	Acute inflammation and lesions of mucous membranes, spread mainly by droplet infection.
(ii)	Tuberculosis (Koch's disease)	<i>Mycobacterium tuberculosis</i>	An acute infection of lungs, lymph and meninges, spread through air when a contaminated person coughs, sneezes, etc.
(iii)	Typhoid fever	<i>Salmonella typhi</i>	High fever with low pulse rate, spreads through contaminated food and water.
(iv)	Tetanus	<i>Clostridium tetani</i>	Spreads through wound infection, spasms of muscles of jaw and neck.

Protozoan diseases

- Transmission of protozoa that live in human's intestine to another human occurs through faecal oral route *e.g.*, Contaminated food and water, person to person contact.
- Protozoa that live in blood or tissue of humans are transmitted to others by an arthropod vector. *E.g.*, through the bite of mosquito or sand fly.
- Common protozoan diseases includes : Giardiasis (caused by *Giardia intestinalis*), trypanosomiasis (caused by *Trypanosoma gambiense*), kala azar (caused by *Leishmania donovani*) and malaria (caused by *Plasmodium vivax*), etc.

Malaria

- Malaria is caused by *Plasmodium*, which completes its life cycle in two hosts : female *Anopheles* mosquito (definitive/primary host) and human beings (intermediate/secondary host).
- When an *Anopheles* mosquito infected with *Plasmodium* penetrates the human skin to obtain blood, then **sporozoites (infective stage)** are released into blood stream of victim.
- Parasite reaches the liver and divides asexually to form **merozoites**.
- Merozoites in blood stream invade the red blood cells and reproduce asexually, causing them to rupture and release toxic substances throughout the body.
- In RBCs, certain merozoites develop into **gametocytes**.
- Female mosquito takes up gametocytes with blood meal. Within the gut of mosquito, gametocytes form gametes and then fertilisation and development takes place.
- The zygote elongates and becomes motile called **ookinete** and differentiates into **oocyst** on the surface of the stomach.
- Within the oocysts, repeated mitotic divisions take place, forming sporozoites.

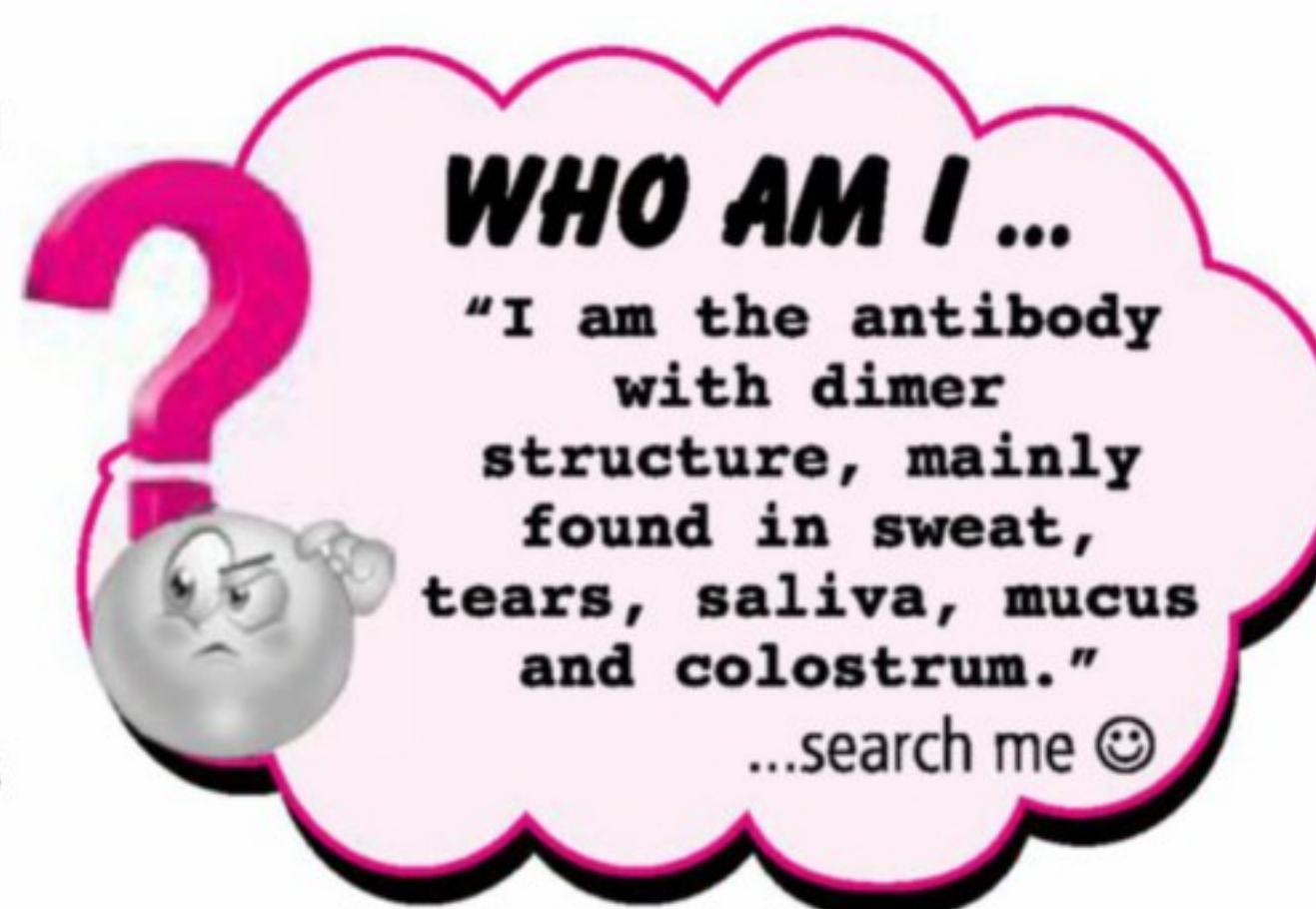
- These sporozoites migrate to the salivary glands of mosquito to start the life cycle again.
- In human beings, malaria is caused by four species that includes *Plasmodium vivax* (cause benign tertian malaria), *P. falciparum* (cause malignant tertian malaria), *P. malariae* (cause Quartan malaria) and *P. ovale* (cause mild tertian malaria).

Helminthic diseases

- Platyhelminthes (flatworms) and nematodes (roundworms), constitute the helminths.
 - Diseases caused by flatworms include taeniasis (by *Taenia solium*), fasciolopsiasis (by *Fasciolopsis buski*), cysticercosis (by *Cysticercus*), etc.
 - Diseases caused by nematodes are ascariasis (by *Ascaris lumbricoides*), filariasis (by *Wuchereria bancrofti*), enterobiasis (by *Enterobium vermicularis*), etc.

Fungal diseases

- These are the diseases caused by fungi. The fungal disease of man are either mycoses (caused by infection of fungi) or toxicoses (caused by toxic fungal metabolites).
- Many fungi belonging to genera *Trichophyton*, *Epidermophyton* and *Microsporum* are responsible for ringworm or tinea in man.
- The genera trichophytons infect skin, hair and nails, e.g., *T. rubrum*.
- *Epidermophyton* attacks the skin and nails but not the hair, e.g., *E. floccsum*.
- *Microsporum* infects the hair and skin but usually not the nails, e.g., *M. canis*.
- Drugs like **Griseofulvin** (orally) and **Miconazole** (topically), inhibits infection.



Non-Communicable Diseases

- These are the diseases usually caused due to genetic or lifestyle factors and are not transmitted from infected to healthy persons.
- Some non-communicable diseases are:
 - Diabetes mellitus (Hyperglycemia)** - It is an endocrine disorder of pancreas. It exists in two forms:
 - The **insulin-dependent diabetes mellitus** (IDDM) caused by a failure of the beta-cells to produce adequate amounts of insulin due to an **autoimmune response**.
 - The **non-insulin-dependent diabetes mellitus** (NIDDM) involve failure of insulin to facilitate the movement of glucose into cells. Symptoms : Elevated glucose concentration in blood, resulting in excessive urination and dehydration. Extreme thirst leading to frequent drinking of water (polydipsia).
 - Cardiovascular diseases**
 - Hypertensive heart diseases -
 - **Arteriosclerosis** : Hardening and loss of elasticity of the arteries.
 - **Atherosclerosis** : Thickness develops on inner walls of the arteries, preventing their dilation.
 - Coronary heart diseases include angina pectoris, myocardial infarction.
 - Arthritis** - Arthritis is not just one disease but a general term that can be applied to as many as twenty five malfunctions of the joints. The causes range from local bacterial infection to injury, allergy or hormonal imbalance. Important types of arthritis are rheumatoid arthritis, osteoarthritis, infectious arthritis and gout.



INTEXT PRACTICE QUESTIONS

1. Name any two type of viral diseases and their pathogens.
2. Which stage of *Plasmodium* invades RBCs and multiply asexually?

IMMUNITY

- **Immunity** is the ability of an organism to protect against all types of foreign bodies like bacteria, virus or toxin, etc. It is also called disease resistance. The lack of immunity is known as susceptibility.
- Immunity is of two types - **innate** and **acquired**. Acquired immunity can be passive or active.

Innate Immunity

- It is the immunity with which an individual is born. It is because of genetic constitutional make up of an organism and has no relationship with previous bacterial infection and immunisation.
 - It is non-specific, *i.e.*, lacks specific response to specific invaders.
 - Innate immunity consists of four types of defence barriers.
- (i) **Physical barriers** include skin (**the first line of defence**) and mucous membranes.
 - **Skin** has outer tough layer called **stratum corneum**, which forms impenetrable barrier to viruses and microorganisms. Skin provides defence with chemical weapons on surface, such as oil and sweat glands that give skin surface a pH of 3-5, acidic enough to inhibit growth of microbes.
 - **Mucous membrane** – Cells lining bronchi and bronchioles secrete sticky mucus that traps microorganisms and immobilise them. The cilia sweeps the mucus loaded with microorganisms and dust particles into pharynx and are expelled through vomiting, coughing and sneezing.
 - (ii) **Physiological barriers** include body temperature, pH of body fluids, various secretions like lysozyme, bile, cerumen (ear wax), vaginal secretion, acid of stomach, etc., that prevents growth of many disease causing microorganisms.
 - (iii) **Cellular barriers** – The surface defences of the vertebrate body are very effective but are occasionally breached, allowing invaders to enter the body. At this point, the body uses a host of non-specific cellular and chemical devices to defend itself referred to **as the second line of defence**. These are certain white blood corpuscles (leucocytes), macrophages, natural killer cells, inflammation, fever, antimicrobial substances, etc., and each kills invading microorganisms differently.
 - **Macrophages** kill microbes by ingesting them through phagocytosis. Macrophage, contains lysosome. Lysosomal enzymes kill the microbes by liberating large quantities of oxygen free-radicals. Macrophages engulf viruses, cellular debris and dust particles in the lungs.
 - **Neutrophils** are short lived leucocytes that ingest and kill bacteria by phagocytosis. In addition, neutrophils release chemicals that kill other bacteria in the neighbourhood as well as neutrophils themselves.
 - **Monocytes** : These are largest leucocytes, these change into macrophages after entering tissue spaces and engulf pathogens and cellular debris.
 - **Inflammatory response** - Inflammation aids the fight against infection by increasing blood flow to the site and raising temperature to retard bacterial growth.
 - This response is a localised, non-specific response to infection. Infected or injured cells release chemical alarm signals, **histamine** and **prostaglandins**. These chemicals promote the dilation of local blood vessels, which increases the flow of blood to the site of infection or injury and causes the area to become red and warm. They also increase the permeability of capillaries in the area, producing the edema (tissue swelling) so often associated with infection. The more permeable capillaries allow phagocytes (monocytes and neutrophils) to migrate from the blood to the extracellular fluid, where they can attack bacteria. Neutrophils arrive first, spilling out chemicals that kill the bacteria in the vicinity (as well as tissue cells and themselves).
 - (iv) **Cytokine barriers** - Cytokines (chemical messengers of immune cells) are low molecular weight proteins that stimulate or inhibit the differentiation, proliferation or function of immune cells. They are involved in the cell to cell communication such as interleukines, lymphokines, tumour necrosis factor and interferons (IFNs).

Acquired Immunity

- Acquired immunity is obtained either from development of antibodies in response to exposure to an antigen as from vaccination or attack from infectious disease, etc., which stimulates antibody production.

Characteristics of acquired immunity

- (i) **Specificity** is the ability to differentiate between various foreign molecules (foreign antigens).
- (ii) **Diversity** can recognise a vast variety of foreign molecules (foreign antigens).

- (iii) **Discrimination between self and non-self** : It can recognise and respond to foreign molecules (non-self) and can avoid response to those molecules that are present within the body (self) of the animal.
- (iv) **Memory** : When the immune system encounters a specific foreign agent, (*e.g.*, a microbe) for the first time, it generates immune response and eliminates the invader. It is called **first encounter**. The immune system retains the memory of the first encounter and as a result, response to a second encounter occurs more quickly than the first encounter.

Components of acquired immunity

(i) Antibody mediated immune system (AMIS) or humoral immunity

- It consists of antibodies that circulate in the body fluids like blood plasma and lymph.
- B-lymphocytes (B-cells) produce antibodies that regulate humoral immunity. T-lymphocytes themselves do not secrete antibodies but help B-lymphocytes produce them. AMIS protects the body from viruses, some bacteria and toxins that enter the body fluids like blood and lymph.

(ii) Cell-mediated immune system (CMIS) or T-Cell immunity

- Lymphocytes are of two types : T-lymphocytes or T-cells and B-lymphocytes or B-cells, produced in the **bone marrow**.
- T-cells play two important functions : **Effector** and **regulatory**. The effector function includes **cytolysis** (destruction of cells by immune processes) of cells infected with microbes and tumour cells and **lymphokine production**. The regulatory functions are either to increase or to suppress other lymphocytes and accessory cells. **CMIS** protects the body against viruses and bacteria which have entered the host's cells. It also reacts against tissue transplants and also against the body's own cells which become cancerous. There are four types of T cells *viz.* helper T cells (T_H), cytotoxic T cells (T_C), memory T cells (Primed cells) and suppressor cells (T_R).

Types of acquired immunity

- (i) **Active immunity** – Person's own cells produce antibodies in response to infection or vaccination. It may be **natural** or **artificial**. **Natural** antigens are introduced through natural exposure while **artificial** antigens are deliberately introduced through vaccination.
- (ii) **Passive immunity** – Ready-made antibodies are directly injected into a person to protect the body against foreign agents. **Natural** antibodies from the mother are transferred to her child across the placenta or in milk and **artificial** antibodies produced by another person or an animal are injected.

Immune Response

- (i) **Primary immune response** is initial encounter of a naive immune-competent lymphocytes with an antigen. There is slow rise in antibody titer, first IgM, followed by IgG.
- (ii) **Secondary immune response** is more rapid and heightened immune response due to subsequent contact of host with same antigen.

Antigens

- These are the substances foreign to the body that evoke an immune response either alone or after forming complex with larger molecules (such as protein) that is capable of binding with product (antibody or T-cell) of immune response.
- Antigens are of two types *i.e.*, complete antigens and incomplete antigens (**haptens**). Complete antigens are able to induce antibody formation alone whereas haptens are incapable of inducing antibody formation alone but can induce antibody formation with large molecules.
- **Antigen Presenting Cells (APCs)** engulf antigens and present fragments to T-cells, *e.g.*, macrophages, dendritic cells and B-cells.

Antibodies

- Antibodies are immunoglobulins (Igs) produced in the body in response to the antigen or foreign bodies. Antibodies are produced by B-lymphocytes and plasma cells. In fact, B-lymphocytes get transformed into plasma cells.
- **Antibody structure** - Each antibody molecule consists of **two light chains** and **two heavy chains**. The four chains in the antibody molecule are held together by disulfide ($-S-S-$) bonds, forming a Y-shaped molecule. Heavy and light chains are joined by disulphide bond, which also joins two heavy chains. This region of antibody is called hinge region.
- There are five types of antibodies:

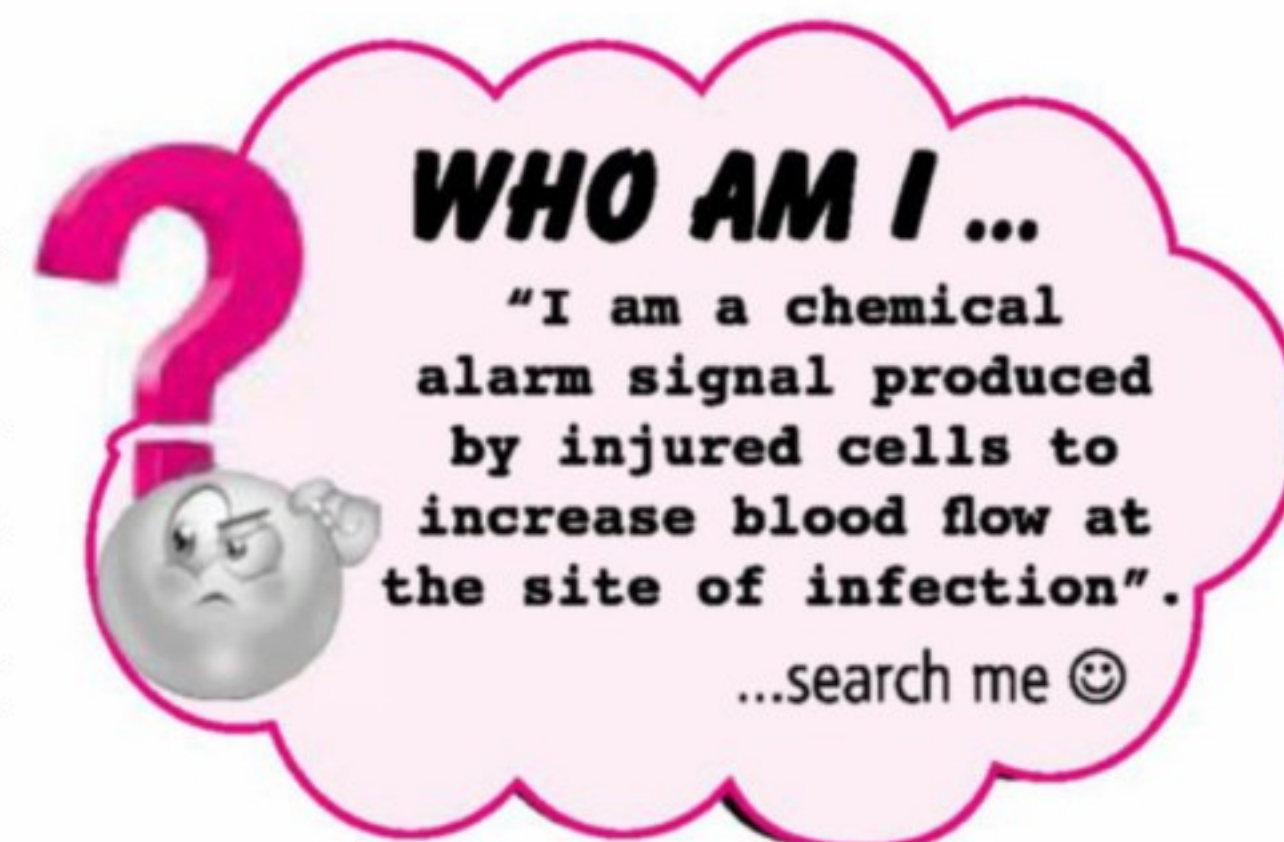
- (a) **IgA** is the second most abundant class of antibody. It is mainly found in sweat, tears, saliva, mucus, colostrum. IgA excreted through faeces is called **coproantibody**.
- (b) **IgD** is mainly found on the surfaces of B-cells as antigen receptors, where it activates B-cells for antigen recognition.
- (c) **IgE** is located on mast cells and basophils releasing histamine. It is involved in allergic and hypersensitivity reactions and also provides protection against parasitic worms.
- (d) **IgG** is the most abundant class of immunoglobulin. It protects the body against bacteria and viruses by enhancing phagocytosis, neutralising toxins and complement activation. It is the only class of antibody which can cross the placenta from mother to fetus.
- (e) **IgM** is the largest immunoglobulin that is secreted first by the plasma cells and also the earliest immunoglobulin to be synthesised by the fetus.

Immune System

- Human immune system consists of lymphoid organs, tissue cells and antibodies.

Lymphoid organs

- Organs where B-lymphocytes and T-lymphocytes mature and acquire their antigen - specific receptors, are primary lymphoid organs, such as bone marrow and thymus. After maturation, lymphocytes migrate to secondary lymphoid organs, where they undergo proliferation and differentiation, it includes lymph nodes, spleen, tonsils, etc.

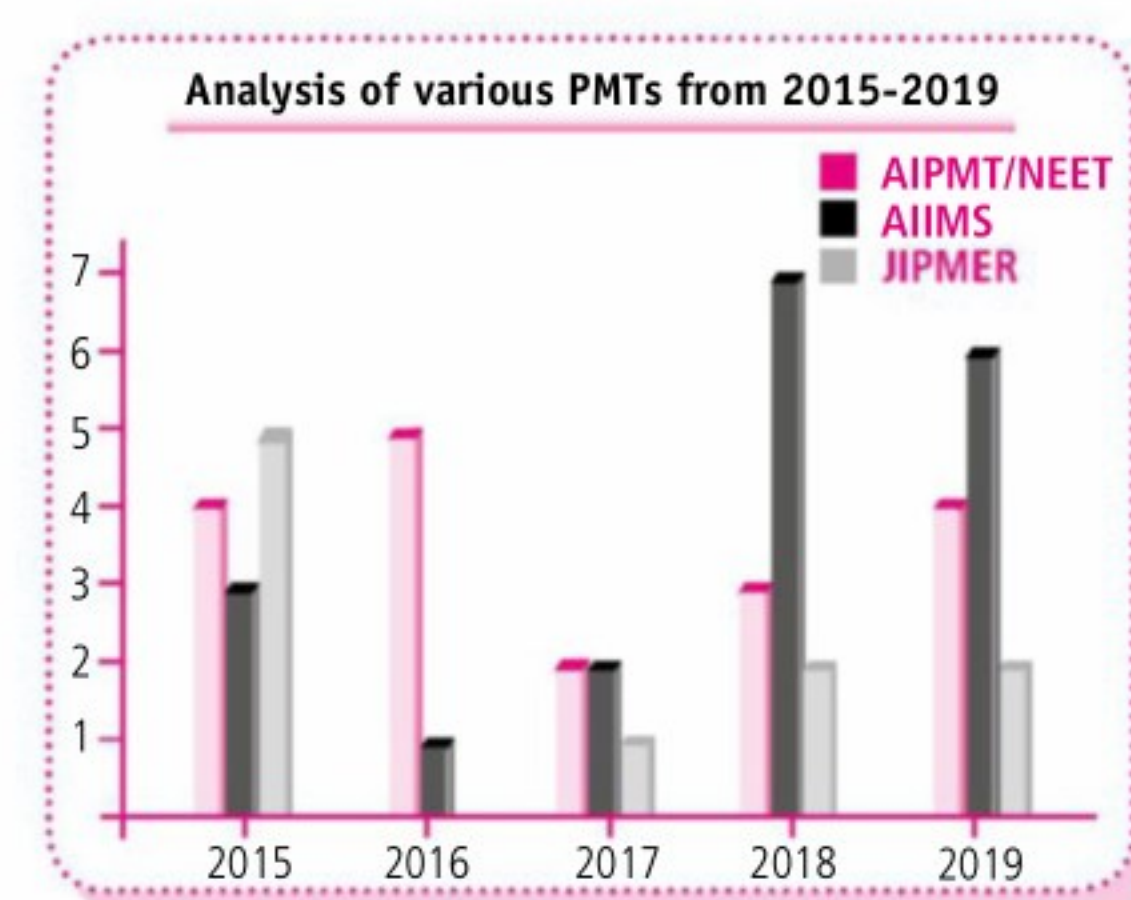


Vaccination

- Vaccine is a preparation or suspension of dead or attenuated (weakened) germs of a disease which on inoculation (injection) into a healthy person provides immunity by inducing antibodies formation. Vaccines work on the basis of property of 'memory' of the immune systems.

Disorders of immune system

- (i) **Autoimmunity** - This type of immunity represents the failure of immune system to recognise self from non-self and start destroying body's own cells. For example, diabetes mellitus, Grave's disease, Hashimoto's thyroiditis, multiple sclerosis, myasthenia gravis, rheumatoid arthritis.
 - (ii) **Allergies** - Allergy is the hypersensitiveness of a person to some foreign substance coming in contact with or entering the body. The common allergens are dust, pollen, mould, spores, fabrics, lipsticks, nail paints, feathers, fur, plants, bacteria, foods, heat, cold, sunlight, etc. The allergic tendency is characterised by the presence of large quantities of IgE antibodies in the blood. First exposure to antigen causes primary immune response, but it does not cause allergy. When an allergen enters the body second time, it causes second immune response reaction and a subsequent allergic reaction occurs. It causes marked dilation of all the peripheral blood vessels and the capillaries become highly permeable so that large amounts of fluid leak out from the blood into the tissues. The blood pressure decreases drastically, e.g., hay fever, asthma, anaphylaxis.
 - (iii) **Immunodeficiency diseases** - These diseases are the conditions in which the defence mechanisms of the body are weakened, leading to repeated microbial infections. For example, a person suffering from SCID may be without B-cells or T-cells or both from the birth. It is **primary immunodeficiency disease**.
- Secondary immunodeficiency diseases** are due to variety of factors such as malnutrition, infections, metabolic disorders, malignancy and cytotoxic drugs may lead to defects in specific and non-specific immunity, examples; AIDS and Hodgkin's disease.



Acquired immuno deficiency syndrome (AIDS)

- AIDS is a disorder of cell-mediated immune system of the body. There is a reduction in the number of helper T-cells which stimulate antibody production by B-cells. This results in the loss of natural defence against viral infection. The infection by **human immuno-deficiency virus** (HIV) causes AIDS. The incubation period of AIDS ranges between 6 months to 10 years.

Transmission of AIDS virus

- It can be transmitted by using contaminated needles and syringes to inject drugs or vaccines, from infected mother to child through placenta, organ transplantation, transfusion of infected blood, by use of contaminated razors, by sexual intercourse with an infected partner without a condom and by artificial insemination.

Mode of action of HIV

- Infection** : Virus enters the body of person and reaches macrophages (cells of immune system).
- Reverse transcription** : The viral RNA is converted to viral DNA with the help of reverse transcriptase enzyme.
- Integration** : Viral DNA is incorporated into the host cell's DNA and gets replicated.
- Multiplication** : The viral DNA replicates along with infected host cell. Thus, the infected macrophages acts as HIV factory.
- Assembly of virus** : The viral proteins formed are assembled to form new viral particles which are released from the infected cell. They mature and target T-cells of body (destroy them).
- Since the number of helper T-lymphocytes decreases in the body, the person starts suffering from infections of bacteria, viruses, fungi and even parasites like *Toxoplasma*.

Cancer

- Cancer is one of the most dreadful disease of human being which is characterised by uncontrolled growth and division of certain body tissues.
- Cancer cells lose the normal feedback control that prevent excessive growth, so these cells grow much more than the normal cells.
- In human body, cell growth and differentiation is highly controlled and regulated, however, in cancerous cells, there is breakdown of these regulatory mechanisms.
- Normal cells show a property called **contact inhibition** by virtue of which contact with other cells inhibits their uncontrolled growth, cancer cells appear to have lost this property.
- As a result of this, cancerous cells just continue to divide giving rise to masses of cells called **tumours**.
- The possible symptoms includes unexplained low grade fever, loss of weight, bleeding from skin, mouth or any other opening etc.

Types of tumours

- On the basis of their spread, tumours are of two types : **benign** and **malignant**.

Benign tumours

- Benign tumours normally remain confined to their original location, do not spread to other parts of the body, cause limited damage and are non-cancerous.

Malignant tumours

- The malignant tumours are a mass of proliferating cells called **neoplastic** or **tumour cells**.
- These cells grow very rapidly, invading and damaging the surrounding normal tissues.
- As these cells actively divide and grow, they also affect the normal cells by competing for vital nutrients.
- Cells sloughed from such tumours reach distant sites through body fluids and wherever they get lodged in the body, they start a new tumour formation there. This property, called **metastasis**.

Causes of cancer

- Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents called **carcinogens**.
- Ionising** radiations like X-rays and gamma rays and **non-ionising** radiations like UV rays cause DNA damage leading to neoplastic transformation.

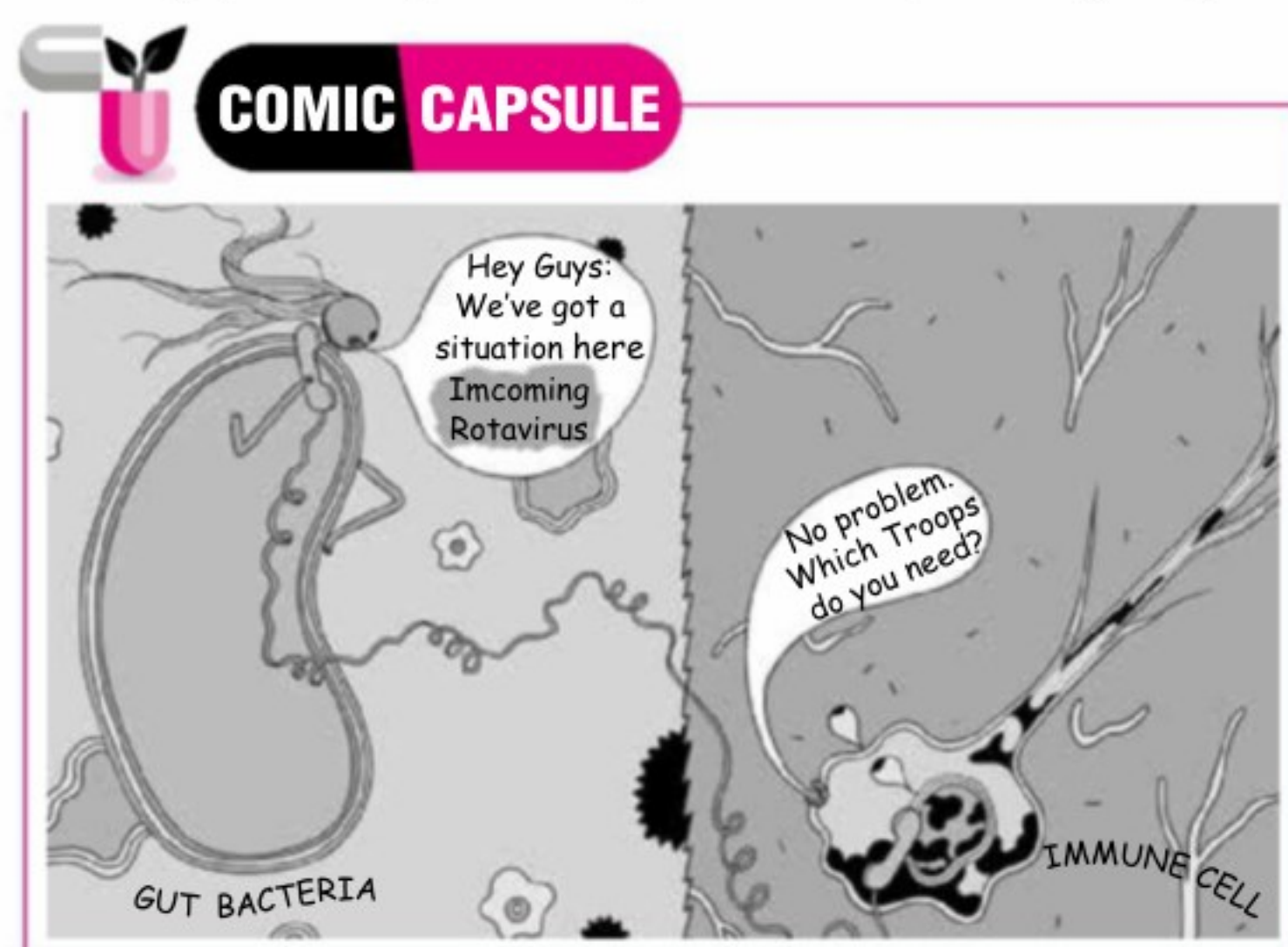
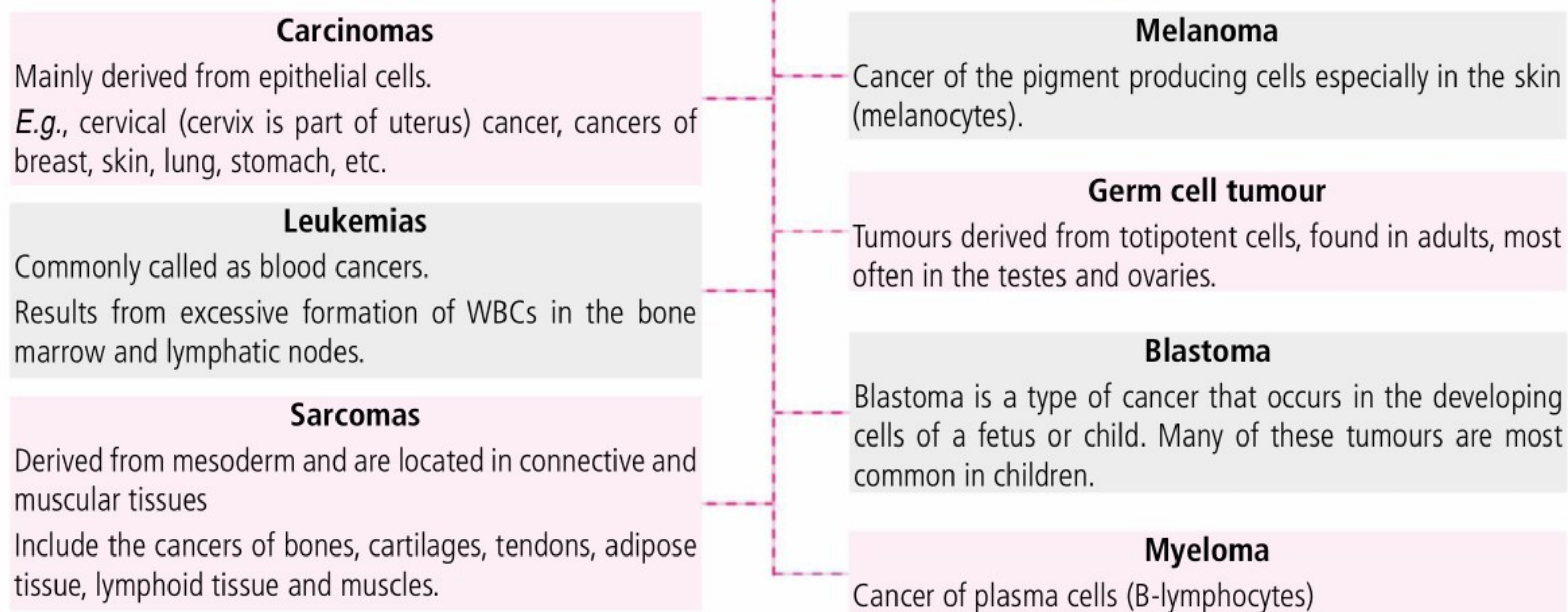


Table : Carcinogens and organs affected

	Carcinogens	Organs affected
(i)	Soot	Skin, lungs
(ii)	Coal tar (3, 4-benzopyrene)	Skin, lungs
(iii)	Cigarette smoke (N-nitrosodimethylene)	Lungs
(iv)	Cadmium oxide	Prostate gland

- The chemical carcinogens present in **tobacco smoke** have been identified as a major cause of lung cancer.
- Cancer causing viruses called **oncogenic viruses** have genes called **viral oncogenes**.
- Several genes called **cellular oncogenes** or **protooncogenes** have been identified in normal cells. They can be activated under certain conditions and could lead to oncogenic transformation of the cells.

Types of cancer on the basis of tissue affected



Cancer Detection and Diagnosis

- Early detection of cancers is essential as it allows the disease to be treated successfully in many cases.
- Cancer detection is based on **biopsy** and **histopathological** studies of the tissue and blood. **Bone marrow** tests for increased cell counts in the case of **leukemias**.
- Techniques like **radiography** (use of X-rays), **CT** (Computed Tomography) and **MRI** (Magnetic Resonance Imaging) are very useful to detect cancers of the internal organs.
- Antibodies against cancer-specific antigens are also used for detection of certain cancers.
- Techniques of **molecular biology** can be applied to detect genes in individuals with inherited susceptibility to certain cancers. Identification of such genes, which predispose an individual to certain cancers, may be very helpful in prevention of cancers.

Treatment of cancer

- The common approaches for treatment of cancer are **surgery, radiation therapy, immunotherapy and chemotherapy**. Most cancers are treated by combination of surgery, radiotherapy and chemotherapy.
- In radiotherapy, tumor cells are irradiated lethally, which destroy rapidly growing cells without harming the surrounding tissue.
- Several chemotherapeutic drugs are used to kill cancerous cells. Some of these are specific for particular tumours. Majority of drugs have side effects like hair loss, anaemia, etc.
- Tumour cells have been shown to avoid detection and destruction by immune system. Therefore, the patients are given substances called **biological response modifiers** such as **interferon** which activate their immune system and help in destroying the tumour.



INTEXT PRACTICE QUESTIONS

3. How many classes of immunoglobulin are found in humans? Name them.
4. Define cancer and mention its causes?

Alcohol Addiction

- Alcohol refers to ethyl alcohol or ethanol (C_2H_5OH) manufactured by fermentation of sugars.

- Drinking of excessive alcohol impairs one's physical, physiological and psychological functions and is referred to as **alcohol abuse**. The dependence or addiction of alcohol is called **alcoholism** and the addict is termed as **alcoholic**. WHO declared in 1964 that alcoholism is a disease.
- The problem associated with alcohol includes social problems such as unemployment, marital tensions, child abuse, financial difficulties, psychological problems such as depression, suicide attempt, etc. and various physical problems.

Drug Addiction

- **Drug addiction** or **drug abuse** is taking drugs for purpose other than clinical use, in amount, concentration or frequency that impairs physical, physiological and psychological functions of the body. The drugs, which are commonly abused are **opioids**, **coca alkaloids** and **cannabinoids**.

Habituating drugs

- Psychotropic drugs** : Mood altering drugs that affect behaviour and mental activity. It includes tranquilisers, sedatives, hypnotics, opioids and stimulants.
Opiate/Opioid/narcotics : Drugs derived from dried latex of unripe fruits of poppy plant (*Papaver somniferum*). They are also called painkillers and have narcotic, analgesic, astringent (that causes contraction of body parts) and sedative effect, *e.g.*, opium (afeem), heroin, smack, etc.
 - Psychedelic drugs**: Drugs change one's behaviour, thoughts, feelings and perceptions without any actual sensory stimulus. It includes LSD, mescaline, psilocybine, cannabinoids, etc.
- **Cocaine** is natural coca alkaloid obtained from leaves of coca (or cocca) plant (*Erythroxylum coca*). Cocaine has **vasoconstrictor properties** and acts as a good local anaesthetic. It is a powerful CNS stimulant. Its overdose causes **hallucinations**.
 - **Hemp** or **cannabinoids** (hallucinogenic chemicals) are obtained from leaves, resin and flowering tips (inflorescence) of hemp plant *Cannabis sativa* that naturally have sedative effects, *e.g.*, bhang, charas, ganja, marijuana, etc.
 - **Tobacco** has volatile poisonous alkaloid called **nicotine** which causes addiction. High concentration of nicotine paralyses nerve cells and may also lead to heart diseases.

Addiction and dependence

- **Addiction** is a psychological attachment to certain effects such as euphoria and a temporary feeling of well-being that is associated with drugs and alcohol.
- **Dependence** is an adaptive state that develops from repeated drug administration. It can result in withdrawal syndrome (anxiety, nausea, shivering), if the drug is abruptly discontinued.

Effects of drugs/Alcohol abuse

- The immediate adverse effects of drugs and alcohol abuse are manifested in the form of **reckless behaviour, vandalism** and **violence**.
- Excessive doses of drugs may lead to coma and death due to respiratory failure, heart failure or cerebral hemorrhage.
- If drugs are taken intravenously (direct injection into the vein using a needle and syringe), there are much more chances to acquire serious infections like AIDS and Hepatitis-B.

Prevention and control

- Psychologists, psychiatrists, deaddiction and rehabilitation specialists are available to help individuals who fall in the trap of drug, tobacco or alcohol abuse.
- Teachers and parents should always be careful to look for and identify danger signs that can indicate tendency to go in for addiction.
- Avoid undue pressure on child because every child has his/her own choice and personality. So, a child should not be pressurised unduly to do beyond his/her capacities, such as in studies or sports, etc.



INTEXT PRACTICE QUESTIONS

5. What are cannabinoids? Give examples along with source plant.

ZOOM IN BI



The syllabus for NEET is very vast which impedes students from acquiring indepth knowledge and covering the entire syllabus at the same time. An important topic for NEET is therefore presented here in elaborate form to enable students grasp the topic, analyse the type of questions and SCORE HIGH.

TRANSCRIPTION AND TRANSLATION

The process by which information from a gene is used in the synthesis of a functional gene products, *i.e.*, proteins is called **gene expression**. The process of gene expression is used by all known life forms, eukaryotes, prokaryotes and utilized by viruses to generate the macromolecular machinery for life. Several steps in the gene expression process modulated include transcription, RNA splicing, translation, and post-translational modification of a protein.

The genetic code stored in DNA is “interpreted” by gene expression to produce proteins needed in a cell. The proteins may have a **structural role**, or a **functional role** which essentially involves controlling cell metabolism. It is the particular range of enzymes in the cell which determines what type of cell it becomes. This way DNA controls the activities of a cell.

The information coded in DNA cannot act directly as a template for protein synthesis. The genetic information of DNA is first transcribed to a messenger RNA (*mRNA*) by the process called **transcription**. **Transcription takes place in the cell nucleus or nuclear region**. The genetic information encoded in messenger RNA (*mRNA*) in the form of a sequence of nucleotide triplets (codons) is translated into a sequence of amino acids in a polypeptide chain through the process called **translation**. **Translation takes place on ribosomes in the cell cytoplasm**.

TRANSCRIPTION

The process of copying genetic information from antisense or template strand of the DNA into RNA is called transcription. Transcription takes place in nucleus in eukaryotic cells.

Principles of complementarity is used even in transcription. The exception is that:

- Instead of thymine, uracil is incorporated opposite to adenine of template strand.
- Only the template strand of the DNA is transcribed.

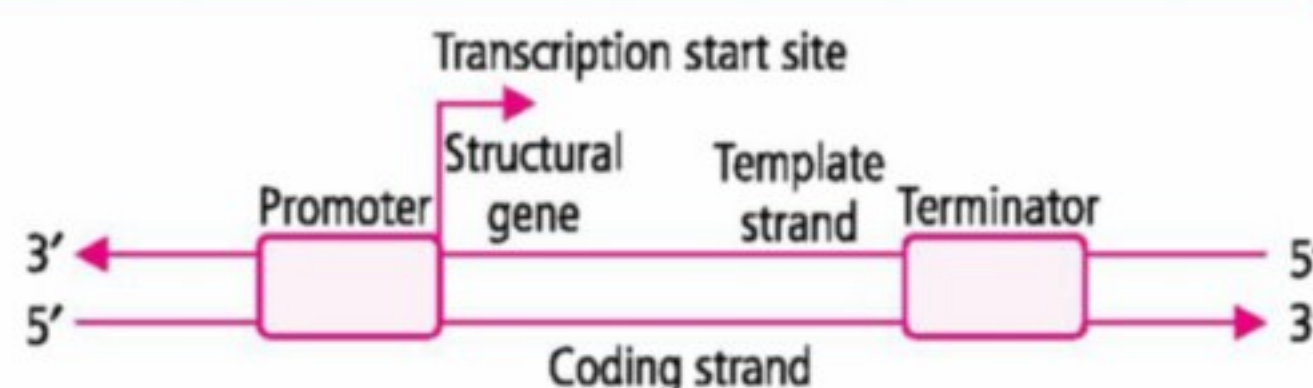
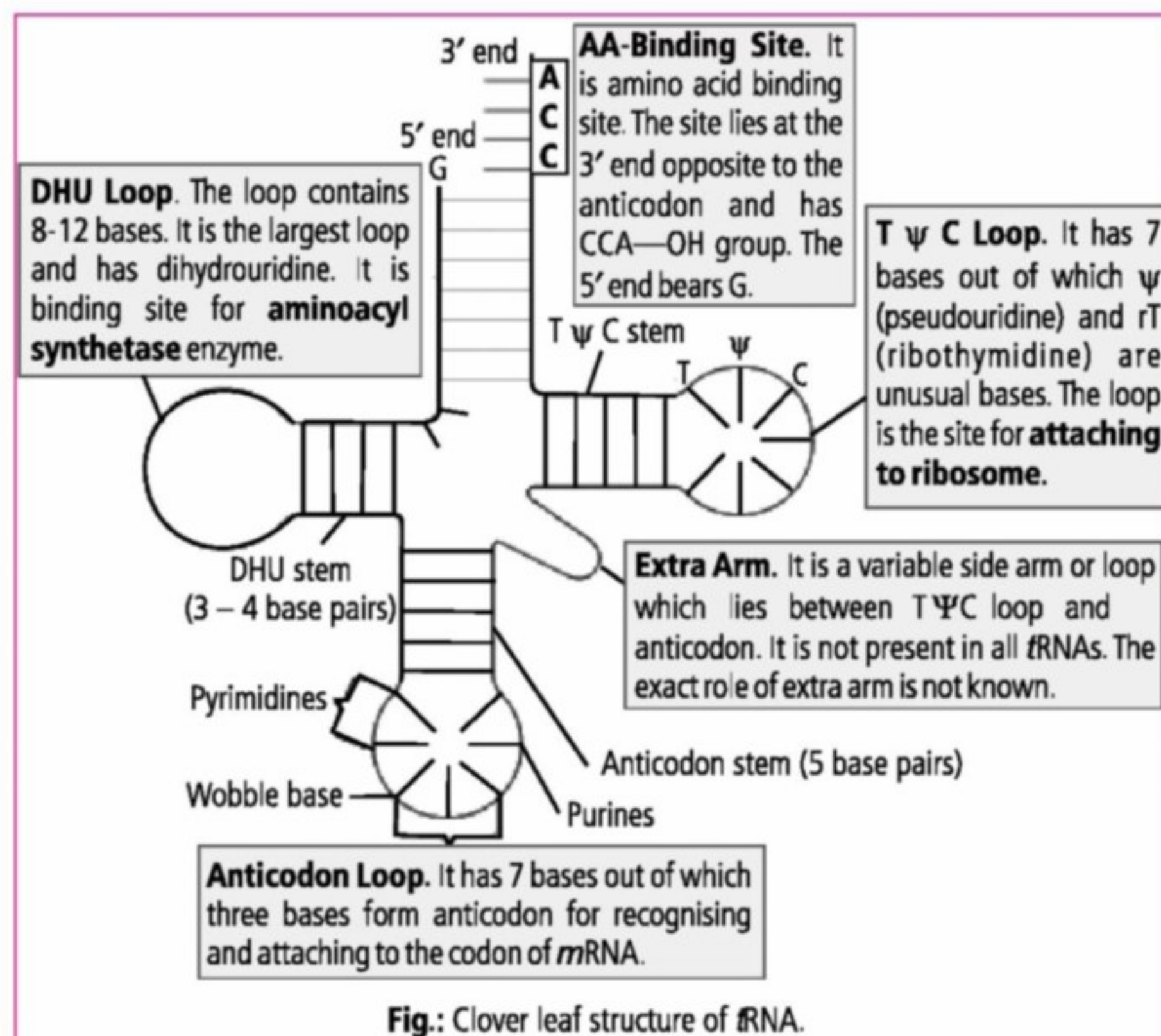
• Snap Shots

- Both the DNA strands cannot be copied during transcription because that will produce two types of proteins, one with correct sequence of amino acids and the other with reverse sequence of amino acids.
- Further, if two complementary RNAs are produced simultaneously, they would have a tendency to form double stranded RNA resulting in nontranslation of coded information into proteins. The whole exercise of transcription would then appear futile.

Transcription Unit

The segment of DNA that takes part in transcription is called transcription unit. It has three components:

- Promoter:** This sequence is present upstream (5' end) of the structural gene of a transcription unit in coding strand. The **binding sites for RNA polymerase** lie within the promoter sequence. Certain short sequences within the promoter sites are conserved. In prokaryotes, 10 bp upstream from the start point lies a conserved sequence described as -10 sequence **TATAAT** or "**Pribnow box**", similarly there is another conserved sequence described as -35 sequence **TTGACA** or "**recognition sequence**." Besides a promoter, eukaryotes also require an **enhancer**.
- Structural gene:** It is the area of template strand that is involved in transcription. Structural genes are of two types - monocistronic and polycistronic. Monocistronic structural gene carries information for synthesis of one polypeptide chain, *e.g.*, eukaryotes and polycistronic structural gene carries information for the synthesis of more than one polypeptide chain, *e.g.*, prokaryotes.
- Terminator:** It is present downstream of the structural gene at 3' end of coding strand or at 5' end of the template strand. It usually defines the end of the process of transcription.



RNA Polymerases

RNA polymerases are a group of enzymes which catalyse the synthesis of RNA using the template DNA. **Ribonucleoside triphosphates are joined together by RNA polymerase, with the elimination of pyrophosphate (PP).** There is a single RNA polymerase in prokaryotes which synthesizes all types of RNAs. Eukaryotes have three types of RNA polymerase *viz.* RNA polymerase I, RNA polymerase II and RNA polymerase III.

RNA polymerase in prokaryotes

RNA polymerase is a **holoenzyme** that is represented as $(\alpha_2\beta\beta'\omega)\sigma$. Molecular weight of holoenzyme is 4,50,000. The enzyme without σ subunit is referred to as **core enzyme**. Though, the core enzyme is capable of transcribing DNA into RNA but transcription starts nonspecifically at any base on DNA. It is σ subunit which confers specificity. **Rho factor (ρ)** is required for termination of transcription.

Table : The functions of the five subunits of the core enzyme

Subunit	Function
β' (largest subunit)	It contains part of the active centre responsible for RNA synthesis and contains some of the determinants for nonsequence-specific interactions with DNA and nascent RNA.
β	It contains the rest of the active centre responsible for RNA synthesis and contains the rest of the determinants for nonsequence-specific interactions with DNA and nascent RNA.
α (α_1 & α_2)	It is present in two copies per molecule of RNA polymerase, α_1 and α_2 . It contains determinants for interaction with promoter DNA, making nonsequence nonspecific interactions at most promoters and sequence-specific interactions at upstream-element-containing promoters, and contains determinants for interactions with regulatory factors.
ω (smallest subunit)	It facilitates assembly of RNA polymerase and stabilizes the assembly.

RNA polymerase in eukaryotes

Eukaryotes have multiple types of nuclear RNA polymerase, each responsible for synthesis of a distinct subset of RNA. All are structurally and functionally related to each other and to bacterial RNA polymerase.

- **RNA polymerase I** synthesizes **28S, 18S and 5.8S rRNAs** which form the major RNA sections of the ribosome.
- **RNA polymerase II** synthesizes **mRNAs, heterogenous nuclear RNA (hnRNA)**. This is the most studied type. As a high level of control is required over transcription, a range of transcription factors are needed for its binding to promoters.
- **RNA polymerase III** synthesizes **tRNAs, 5S rRNA and snRNA**.

Mechanism of Transcription

Transcription involves three different stages – **initiation**, **elongation** and **termination**.

Initiation

The first step in transcription is binding of RNA polymerase to DNA at promoter region at 5' end to form **closed promoter complex**. A **promoter region** has **RNA polymerase recognition site** and **RNA polymerase binding site**.

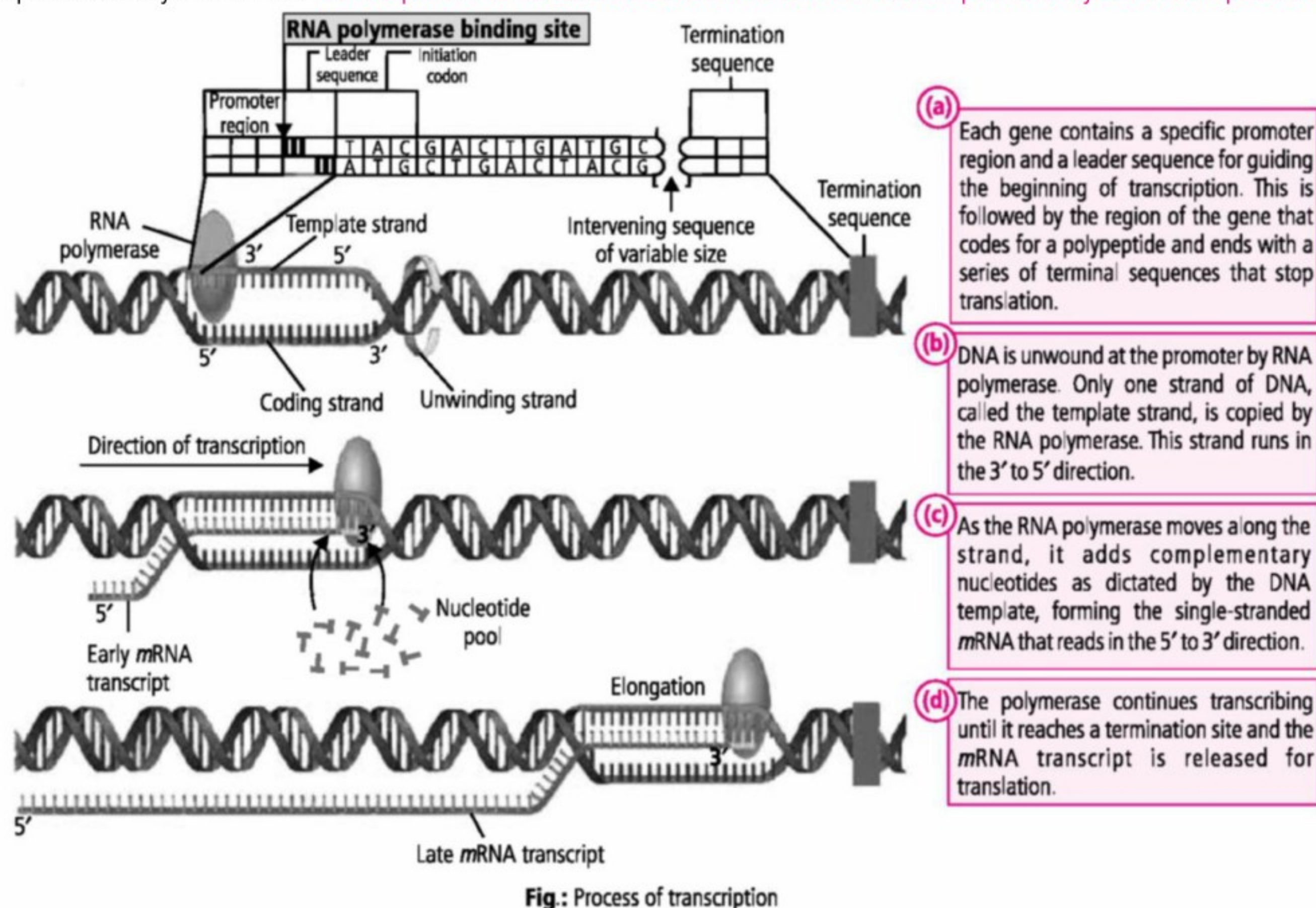
When the closed promoter complex forms, DNA remains double helical. It then isomerizes and causes unwinding and separation of DNA strands to form **open promoter complex**, a highly stable structure.

RNA polymerase contains two nucleotide binding sites: initiation site and elongation site.

- **Initiation site** binds only with purine triphosphates (ATP and GTP). The initiating nucleoside triphosphate binds to the enzyme in open promoter complex and forms hydrogen bond with complementary DNA base (base pairing).
- **Elongation site** is then occupied by a nucleoside triphosphate that is selected strictly on the basis of its ability to form hydrogen bond with the next base in DNA strand. The two nucleotides are then joined together and the first base pair is released from initiation site.
- RNA polymerase initiates transcription. It uses nucleoside triphosphate as substrate and polymerase in a template dependent fashion following the rule of complementarity.

Elongation

Elongation phase starts with the release of sigma (σ) factor from RNA polymerase. The elongation of chain is brought about by **core polymerase enzyme** with the help of which the adjacent ribonucleotides held over DNA template join to form RNA chain. RNA is synthesized from **5' end to 3' end (5' → 3')** antiparallel to the DNA template. For addition of each nucleotide to the growing chain, a pyrophosphate moiety is released. The sequence of nucleotide bases in the **mRNA** is complementary to the template DNA strand.



Termination

The process of transcription stops by termination signals. Two types of termination are identified :

(a) **Rho (ρ) dependent termination:** A specific protein, named **ρ factor**, binds to the growing RNA (and not to RNA polymerase) and in the bound state it acts as ATPase and terminates transcription and releases RNA. **The ρ factor is also responsible for the dissociation of RNA polymerase from DNA.**

(b) **Rho (ρ) independent termination:** In this case the termination is brought about by the formation of **hairpin loop** of newly synthesized RNA. **This occurs due to the presence of palindromes (sequences of base pairs that read the same on two strands of DNA when orientation of reading is kept same). As a result of this, the newly synthesized RNA folds to form hairpins (due to complementary base pairing) that cause termination of transcription.**

As the RNA chain is released, the transcribed region of the DNA molecule again gets hydrogen bonded to the sense strand and the two are spirally coiled to assume the original double helical form (**duplex formation**).

Post-transcriptional Processing

In prokaryotes, the transcription product directly functions as *mRNA*, but in eukaryotes the result of transcription is hnRNA. hnRNA contains both introns and exons.

Transcription in eukaryotes occurs within the nucleus and hnRNA moves out of the nucleus into the cytoplasm for translation. The functional *mRNA* is processed from the primary RNA transcript, and the process is called **maturation**. This post-transcriptional processing involves the following:

(a) **Modification of 5' end by capping:** Capping at 5' end occurs rapidly after the start of transcription. **The methylated (guanosine) at 7th position is added at 5' with the help of enzyme guanyl transferase.**

The cap structure has no free phosphates, and the *mRNA* is thus protected against attack by phosphatases and other nucleases. The cap is important in *mRNA* translation because *mRNA* is otherwise unable to form an initiation complex with 30S ribosomal subunit.

(b) **Polyadenylation at 3' end (Tailing) :** Poly A is added to 3' end of newly formed hnRNA with the help of enzyme **Poly A** polymerase. It adds about **200-300 adenylate residues**. Not all *mRNAs* are polyadenylated; most prominent of them are histone *mRNAs*. Poly A has a role in promoting ***mRNA* stability**. It is thought to protect 3' end from degradation by exonuclease.

(c) **Splicing of hnRNA (Tailoring):** Most genes are interrupted by insertions of noncoding DNA, which are later excised at the RNA level and the molecule precisely religated in a process called **RNA splicing**. The extra segments that are removed are called **introns** or intervening sequences, and the segments that constitute the mature *mRNA* are called exons or expressing sequences.

Each intron starts with dinucleotide GU and ends with dinucleotide AG (**GU – AG rule**). They are recognised by components of splicing apparatus of Sn-RNPs (pronounced **as snurps**) or small nuclear ribonucleoproteins (viz. U1, U2, U4, U5, U6). A complex called **spliceosome** is formed between 5' end (GU) and 3' end (AG) of intron. Energy is obtained from ATP. It removes the intron. The adjacent exons are brought together. The ends are sealed by **RNA ligase**. The fully processed hnRNA is now called *mRNA*.

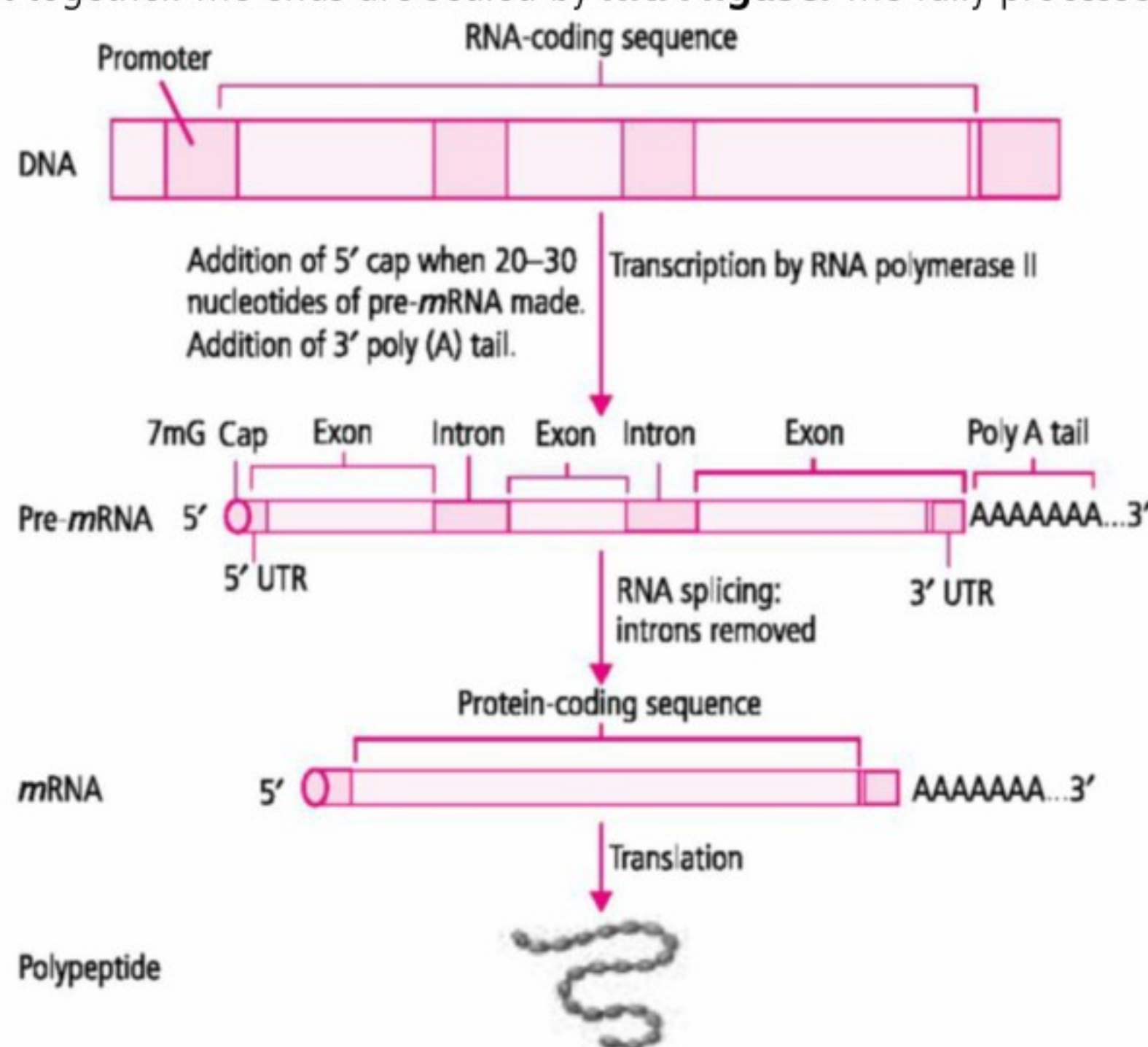


Fig.: Post transcriptional processing of *mRNA* in eukaryotes

The presence of introns might provide a signal indicating that a particular RNA cannot be released to the cytoplasm, which is important, because there it would be translated into an incorrect protein product. Thus **splicing is completed in the nucleus before the mRNA molecule is transported into the cytoplasm.**

RNA editing

In the late 1980s, still another quite unexpected form of post-transcriptional RNA processing was discovered in several organisms. In this form, referred to as RNA editing, the nucleotide sequence of a pre-mRNA is actually changed prior to translation. As a result, the ribonucleotide sequence of the mature RNA differs from the sequence encoded in the exons of the DNA from which the RNA was transcribed.

While there are numerous variations of RNA editing, the two main types studied initially include **substitution editing**, in which the identities of individual nucleotide bases are altered. Such as conversion of cytidine in the RNA to uracil by cytidine deaminases enzymes and **insertion/deletion editing**, in which nucleotides are added to or subtracted from the total number of bases. Insertion and deletion are mediated by G protein.

Table: Differences between prokaryotic and eukaryotic transcription

	Prokaryotic transcription	Eukaryotic transcription
(i)	It occurs in cytoplasm.	It occurs inside the nucleus.
(ii)	It is coupled to translation.	Transcription and translation are spatially separate.
(iii)	There is only one RNA polymerase.	There are three types of RNA polymerases.
(iv)	mRNA is generally polycistronic.	mRNA is generally monocistronic.
(v)	Splicing is generally not required.	In most of the cases splicing is required for removing intervening sequences.

Table: Effects of antibiotics/toxins on transcription

	Antibiotic	Effects
(i)	Actinomycin D	Synthesized by <i>Streptomyces</i> , binds with DNA template strand and blocks the movement of RNA polymerase.
(ii)	Rifampicin	Binds with β -subunit of prokaryotic RNA polymerase and inhibits its activity.
(iii)	α -Amanitin	Produced by mushroom <i>Amanita phalloides</i> , tightly binds with RNA polymerase II of eukaryotes and inhibits transcription.

TYPES OF RNA

Ribonucleic acid (RNA) is a ubiquitous family of macromolecule that perform multiple vital roles in the coding, decoding, regulation and expression of genes.

Messenger RNA (mRNA)

It is a long RNA which constitutes 2–5% of the total RNA content of the cell. It brings instructions from the DNA for the formation of particular type of polypeptide. mRNA is, therefore, also called **informational** or **genetic RNA**. The instructions are present in the base sequence of nucleotides, which is called **genetic code**.

In prokaryotes, shine dalgarno sequence is present at 5' terminus however, in eukaryotes, mRNA has **methyated region** at the 5' terminus. It functions as a **cap** for attachment with ribosome. **Cap is followed by an initiation codon (AUG)** either immediately or after a small **noncoding leader region**. Then there is **coding region** followed by **termination codon (UAA, UAG, or UGA)**. After termination codon there is a small non-coding trailer region and **poly A area** or **tail** at the 3' terminus. The leader and trailer regions are called **UTRs (Untranslated regions)**.

UTR (Untranslated regions) are not translated. They are transcribed as part of same transcript as the coding region. **Such UTRs provide stability to mRNA and also increase translational efficiency.**

When a particular gene codes for a mRNA strand it is said to be **monocistronic** or **monogenic**. When several genes (cistrons) are transcribed into a single mRNA molecule, it is described as **polycistronic** or **polygenic**. Monocistronic mRNA codes for one complete protein molecule while polycistronic mRNA codes for a number of protein molecules.

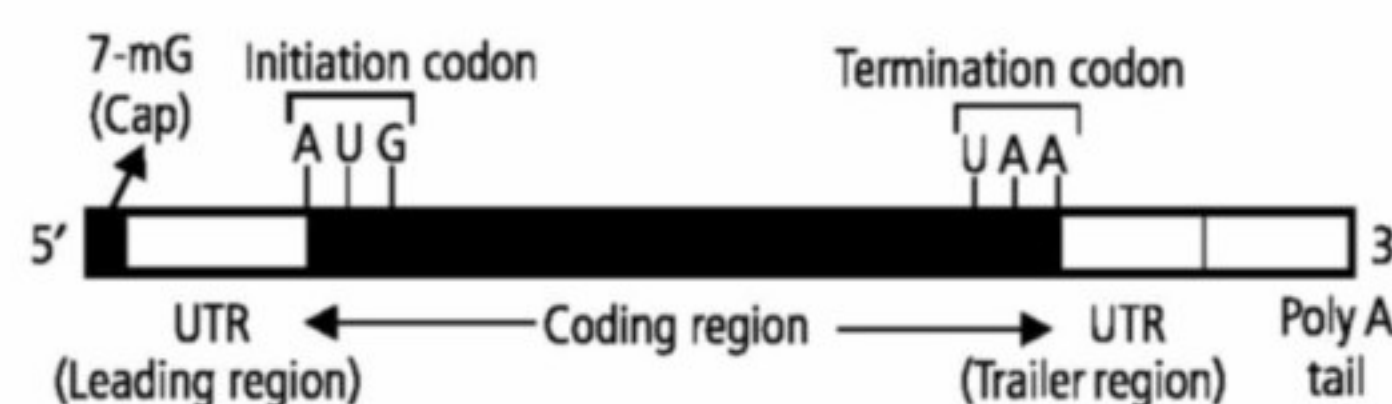


Fig.: Structure of mRNA

Table: Differences between prokaryotic and eukaryotic mRNA

	Prokaryotic mRNA	Eukaryotic mRNA
(i)	It is polycistronic.	It is monocistronic.

(ii)	Its translation begins even during transcription.	Its translation begins only when the transcription has been completed.
(iii)	It is short lived.	It is more stable.
(iv)	It hardly undergoes any processing.	It undergoes processing (capping, methylation and polyadenylation)

Ribosomal RNA (rRNA)

It is the most abundant RNA (70-80% of total), which has 3-4 types. rRNA or ribosomal RNA is formed from the nucleolar organizing region. It is involved in the translation of message from DNA.

It attracts and provide large surface for spreading of mRNA over ribosomes during translation or process of protein synthesis. It forms the structural bench work on which a polypeptide is formed, during protein synthesis.

In *E.coli* (prokaryote) rRNA are in three forms, sedimenting into 23S, 16S and 5S. In eukaryotic cells, which have larger ribosomes than prokaryotes, there are four types of rRNA: 5S, 5.8S, 18S, and 28S.

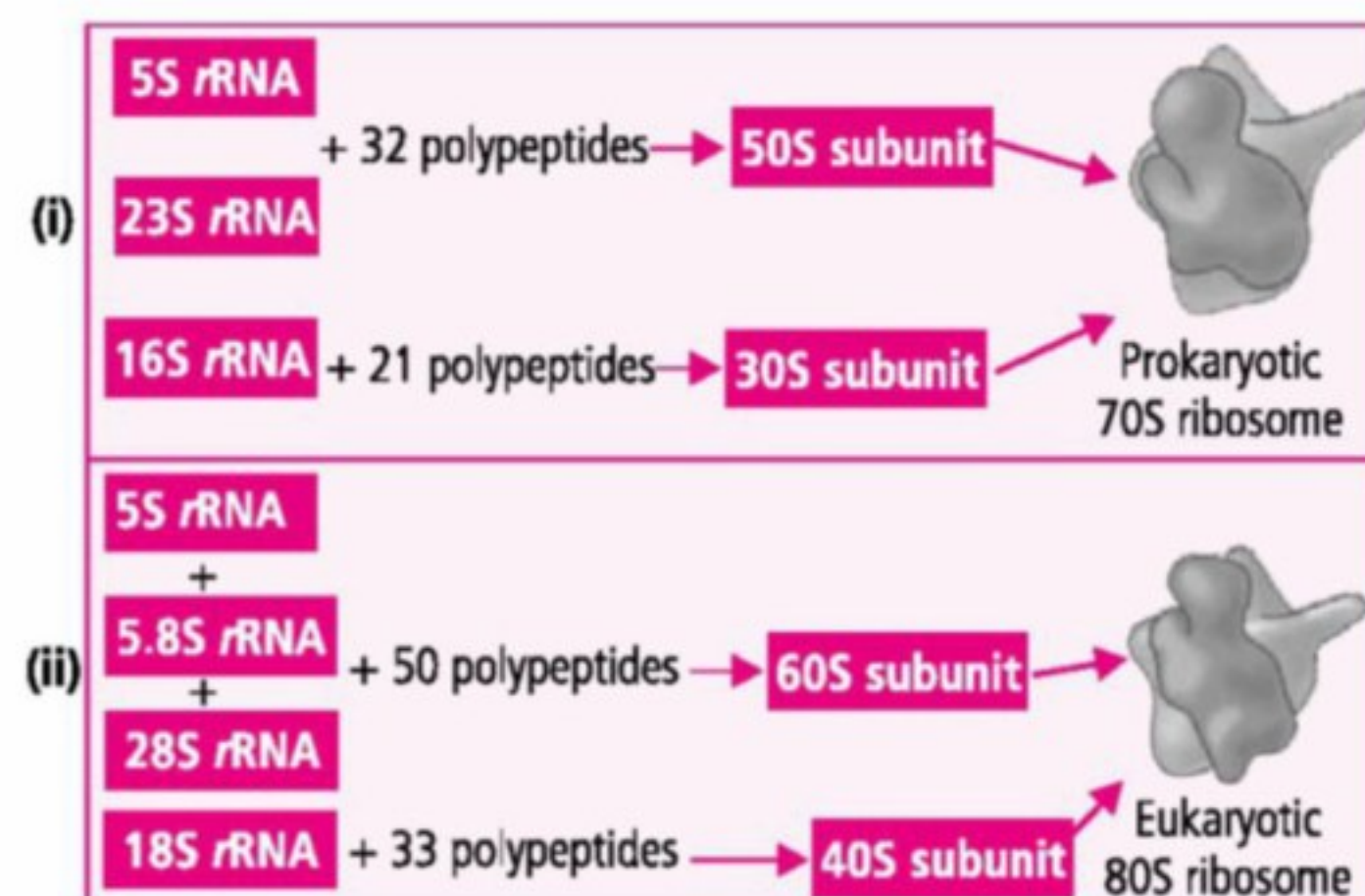


Fig.: (i) Prokaryotic rRNA (ii) Eukaryotic rRNA

Transfer RNA (tRNA)

Transfer RNAs constitutes about 15% of total RNA and are also known as **soluble RNA** or **adaptor RNAs**. tRNA are smallest, bearing 73-93 nucleotides and sedimentation coefficient of 4S. tRNA is single stranded but the nitrogen bases of several of its nucleotides gets modified e.g., pseudouridine, dihydrouridine, inosine, ribo-thymidine. This causes coiling of tRNA in the shape of **clover leaf**. The first person to determine the base sequence of a tRNA molecule was **Robert Holley**. Holley (1965) reported the sequence of an alanine tRNA from yeast and proposed two-dimensional structure of tRNA (clover leaf model). About half of the nucleotides are base paired to produce paired stem. Five regions are unpaired or single stranded viz. A.A binding site, T ψ C loop, DHU loop, extra arm and anticodon loop.

TRANSLATION

Translation or protein synthesis is a process during which the genetic information stored in the sequence of nucleotides in an mRNA molecule is translated, following the dictation of the genetic code, into the sequence of amino acids in the polypeptide.

Translation Machinery

It consists of ribosomes, amino acids, mRNA, tRNAs and amino acyl tRNA synthetases. mRNA functions as a template having genetic information. Ribosome is the site of protein synthesis. tRNA brings the desired amino acid, reads the genetic information and places the amino acid at proper place.

Ribosomes

Protein synthesis occurs over the ribosomes. Ribosomes are, therefore, also called **protein factories**. Each ribosome has two unequal parts, small and large. The **larger subunit** of ribosomes has a groove for pushing out the newly formed polypeptide and protecting the same from cellular enzymes. The **smaller subunit** fits over the larger one like a cap but leaves a tunnel for mRNA. The two subunits come together only at the time of protein formation. The phenomenon is called **association**. Mg²⁺ is essential for it. Soon after the completion of protein synthesis, the subunits separate. The phenomenon is called **dissociation**.

Translation amplification

In prokaryotes, ribosomes usually form rosette or helical groups during active protein synthesis. They are known as **polyribosomes** or **polysomes** (Rich, 1963). The different ribosomes of a polysome are held together by a strand of messenger RNA. Polyribosomes helps to produce a number of copies of the same polypeptide. This is known as translational amplification.

The different parts of a ribosome connected with protein synthesis are :

- A **tunnel** for mRNA which lies between the two subunits :
- A **groove** (part of the **larger subunit**) for passage of newly synthesized polypeptide.
- Three reactive sites – **P-site** (peptidyl transfer or donor site), **A-site** (amino-acyl or acceptor site) and **E** or **exit site**. P site is jointly contributed by both ribosomal subunits. A site and E site are largely confined to the larger subunit of ribosome.
- Enzyme **peptidyl transferase** is a **ribozyme**. It is component of larger subunit of ribosome.

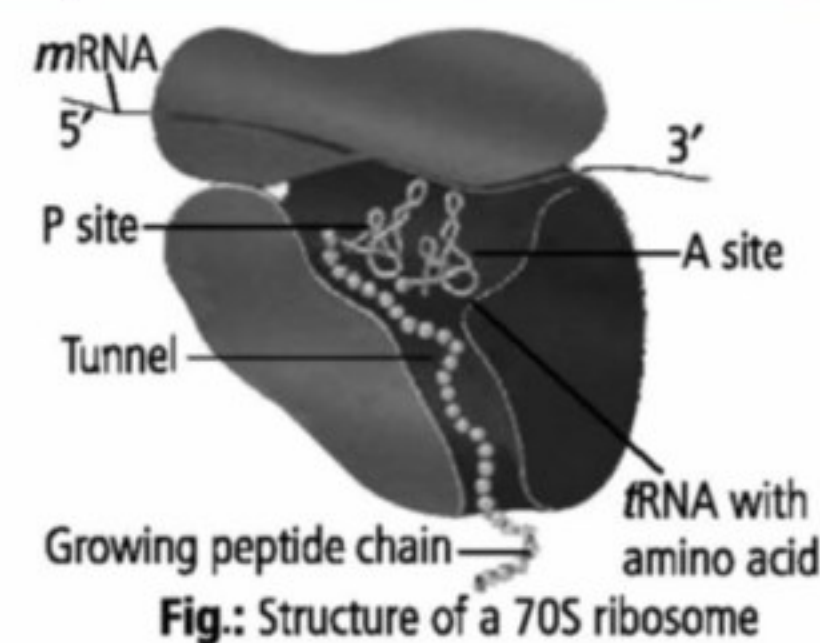


Fig.: Structure of a 70S ribosome

Amino acids

Hundreds of different types of proteins may be manufactured in a single cell. There are some 20 amino acids which constitute building blocks of proteins. All types of proteins are formed from the same amino acids. **It is the arrangement of amino acids in the polypeptides and the number of the latter which provide specificity to the proteins.** They occur in the cellular pool.

mRNA and tRNA

tRNA are transfer or soluble RNAs which pick up particular amino acids (at CCA or 3' end) in the process called **charging**. The charged tRNAs take the same to mRNA, over particular codons corresponding to their anticodons. **A tRNA can pick up only a specific amino acid though an amino acid can be specified by 2-6 tRNAs.**

Amino-acyl tRNA synthetase

It is the enzyme that helps in combining amino acid to its particular tRNA. The enzyme is specific for each amino acid. It is also called aa-activating - enzyme.

Mechanism of Translation

Charging of tRNA

Before translation can proceed, the tRNA molecules must be chemically linked to their respective amino acids. This activation process, called charging, occurs under the direction of enzymes called aminoacyl tRNA synthetases.

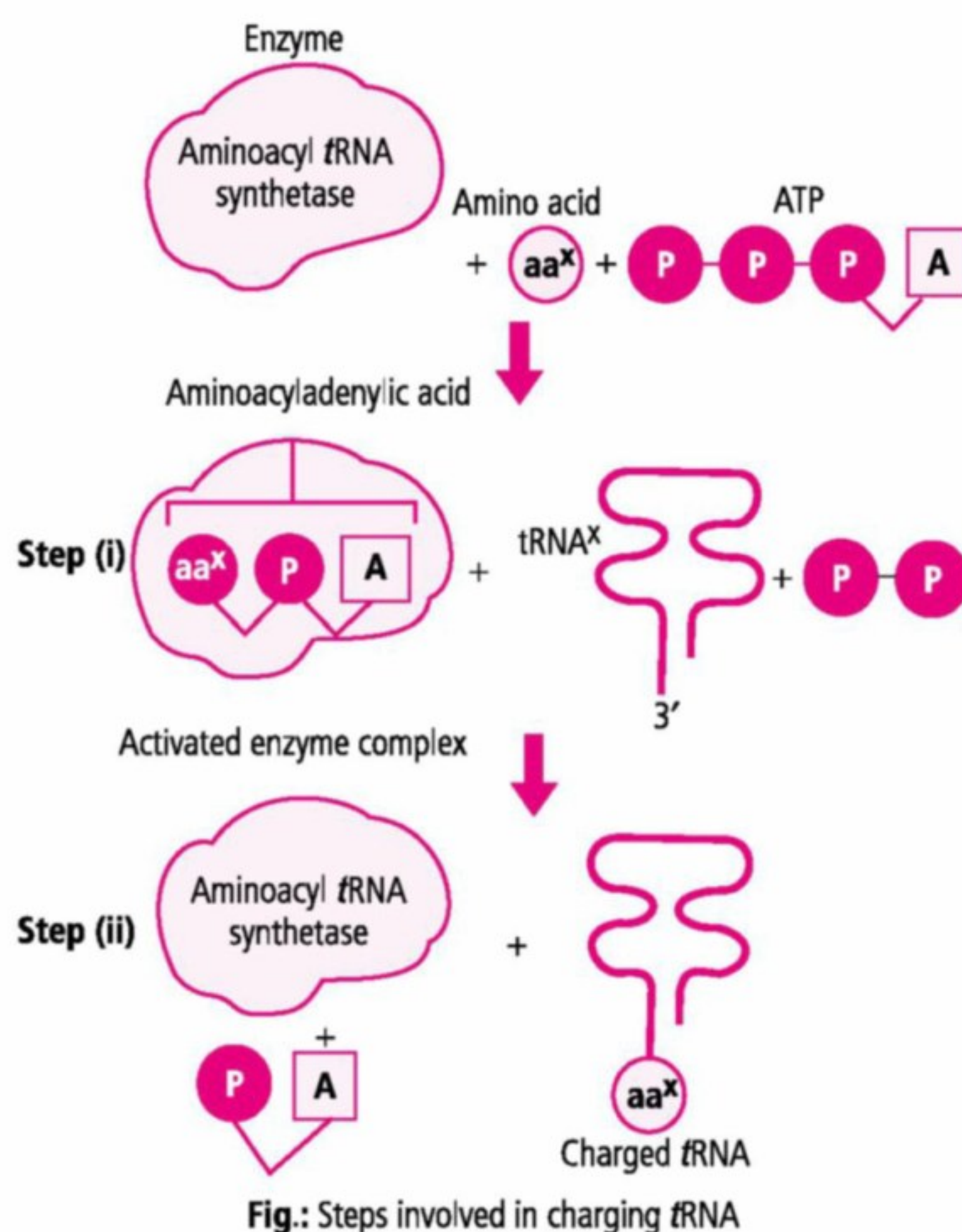
Because there are 20 different amino acids, there must be at least 20 different tRNA molecules and as many different enzymes. However, because of the ability of the third member of a triplet code to "wobble," it is now thought that there are at least 32 different tRNAs; it is also believed that there are only 20 synthetases, one for each amino acid, regardless of the greater number of corresponding tRNAs.

- (i) In the initial step, the amino acid is converted to an activated form, reacting with ATP to create an **aminoacyladenyllic acid**. A **covalent linkage** is formed between the 5'-phosphate group of ATP and the carboxyl end of the amino acid. This molecule remains associated with the synthetase enzyme, forming an amino-acyladenylate enzyme complex that then reacts with a specific tRNA molecule. The energy made available to amino acid during its activation is later used in formation of peptide bond.
- (ii) In the next step, the amino acid is transferred to the appropriate tRNA and bonded covalently to the adenine residue at the 3' end. The charged tRNA may participate directly in protein synthesis.

Aminoacyl tRNA synthetases are highly specific enzymes because they recognize only the amino acid.

Initiation

Initiation of translation in prokaryotes involves the small ribosome subunit, an mRNA molecule, a specific charged initiator tRNA, GTP, Mg^{2+} , and a number of proteinaceous **initiation factors (IFs)**. These are initially part of the small subunit and are required to enhance the binding affinity of the various translational components. The small ribosomal subunit binds to initiation factors, such as IF₁ and IF₃ and this complex in turn binds to mRNA (Step 1). IF₃ binds to the 30S ribosomal subunit and is required for its binding to the mRNA starting site. IF₃ also functions as a ribosome dissociation factor.



Shine-Dalgarno Sequence

- In bacteria, such binding involves a sequence of upto six ribonucleotides (AGGAGG), which precedes the initial AUG start codon of *mRNA*. This sequence (containing only purines and called the **Shine-Dalgarno sequence**) base-pairs with a region of the 16S *rRNA* of the small ribosomal subunit, facilitating initiation.
- It is named after Australian researchers John Shine and Lynn Dalgarno, who identified it in the *mRNA*. This consensus sequence is an initiation signal of four to nine purine residues, 8 to 13 bp prior to the 5' side of the initiation codon. The sequence base pairs with a complementary pyrimidine rich sequence near the 3' end of the 16S *rRNA* of the 30S ribosomal unit. This *mRNA-rRNA* interaction positions the initiating 5' AUG sequence of the *mRNA* in the precise position on the 30S subunit where it is required for initiation of translation.

- IF₂ then enhances the binding of charged **fmet** *tRNA* to the small subunit in response to the AUG triplet. This step 'sets' the reading frame so that all subsequent groups of three ribonucleotides are translated accurately.
- IF₁ participates in the interaction between IF₂ and the initiator *tRNA*.

The aggregate represents the **initiation complex**, which then combines with the large ribosomal subunit. In this process, a molecule of GTP is hydrolyzed, providing the required energy, and the initiation factors are released.

The fMet-*tRNA* is the only aminoacyl-*tRNA* that binds first to the P site; during the subsequent elongation stage, all other incoming aminoacyl-*tRNAs* bind first to the A site and subsequently to the P and E sites. During initiation, factor IF₁ binds at the A site and prevents *tRNA* binding at this site.

Initiation in eukaryotes is similar, although it differs in two important ways.

- First, in eukaryotes, the initiating amino acid is methionine rather than N-formylmethionine.
- Second, the initiation complex is far more complicated than in bacteria, containing nine initiation factors, many consisting of several subunits. These initiation factors are eIF2, eIF3, eIF1, eIF4A, eIF4B, eIF4C, eIF4D, eIF5, eIF6.

Elongation

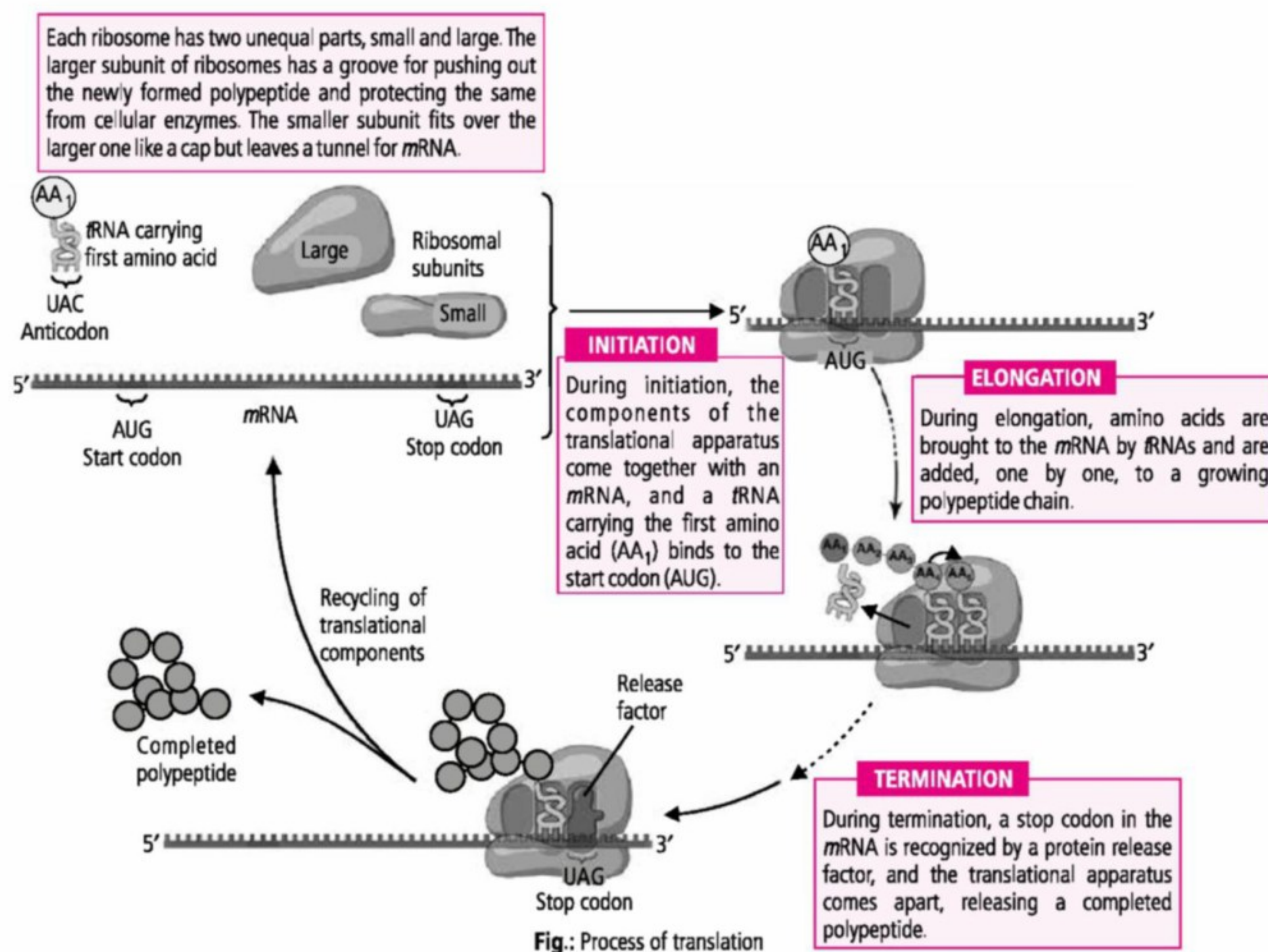
The sequence of the second triplet in *mRNA* dictates which charged *tRNA* molecule will become positioned at the A site. Once it is present, **peptidyl transferase** catalyzes the formation of the peptide bond that links the two amino acids together. At the same time, the covalent bond between the amino acid and the *tRNA* occupying the P site is hydrolyzed (broken). The product of this reaction is a dipeptide, which is attached to the 3' end of *tRNA* still residing in the A site. Before elongation can be repeated, the *tRNA* attached to the P site, which is now uncharged, must be released from the large subunit. The uncharged *tRNA* moves transiently through a third site on the ribosome called the E site (E stand for exit). The entire *mRNA-tRNA-aa2-aa1* complex then shifts in the direction of the P site by a distance of three nucleotides.

This event requires several protein **elongation factors (EFs)** as well as the energy derived from hydrolysis of GTP.

- EFTu (Tu stands for temperature-unstable factor) forms a complex with an aminoacyl-*tRNA* and GTP and brings them to the ribosome. It is used to carry all other aminoacyl-*tRNAs* to the site of chain elongation. Once the AA-*tRNA* is in place, the GTP is hydrolyzed and EFTu is released from the ribosome.
- EFTs (Ts stands for temperature-stable factor) catalyzes the formation of the complex between EFTu, AA-*tRNA*, and GTP.
- EFG also called translocase, is involved in the translocation process that occurs when the ribosome moves from one codon to the next along the *mRNA*.

The result of all these events is that the third triplet of *mRNA* is now in a position to accept another specific charged *tRNA* into the A site. The sequence of elongation is repeated over and over. An additional amino acid is added to the growing polypeptide chain each time the *mRNA* advances through the ribosome. The energy for peptide bond formation is stored in the AA ~ *tRNA* and comes from an ATP molecule used during the aminoacylation of *tRNA*. Thus protein synthesis is expensive in terms of energy; for each amino acid incorporated, one ATP and two GTP molecules are required. The elongated polypeptide chain lies in the groove.

In eukaryotes, the elongation cycle is quite similar to that in prokaryotes. Three eukaryotic elongation factors (eEF1 α , eEF1 β , and eEF2) have functions analogous to those of the prokaryotic elongation factors (EF-Tu, EF-Ts, and EF-G, respectively). Besides, eukaryotic ribosomes do not have an E site; uncharged *tRNAs* are expelled directly from the P site.



Termination

Elongation continues until the ribosome adds the last amino acid coded by the *mRNA*. Termination, is signaled by the presence of one of three **termination codons** in the *mRNA* (**UAA, UAG, UGA**), immediately following the final coded amino acid.

In prokaryotes, there are three releasing factors: RF-1, RF-2 and RF-3.

- **RF-1** recognizes the **termination codons UAG and UAA**, and
- **RF-2** recognizes **UGA and UAA**.
- **RF-3** is thought to **release the ribosomal subunit**.

In eukaryotes, a single release factor, **eRF**, recognizes all three termination codons.

Table : Various protein factors involved during translation in *E.coli*

	Process	Factor	Role
(i)	Initiation of translation	IF ₁	Increase the affinity of IF2 and IF3 towards 30S subunit.
		IF ₂	Recruits initiator <i>tRNA</i> to the small ribosomal subunit and facilitates joining of larger subunit.
		IF ₃	Binds 30S subunit to <i>mRNA</i> ; dissociates monosomes into subunits following termination.
(ii)	Elongation of polypeptide	EF-Tu	Binds GTP; brings aminoacyl- <i>tRNA</i> to the A site ribosome.
		EF-Ts	Generates active EF-Tu
		EF-G	Stimulates translocation; GTP-dependent.
(iii)	Termination of translation and release of polypeptide	RF1	Catalyzes release of the polypeptide chain from <i>tRNA</i> and dissociation of the translocation complex; specific for UAA and UAG termination codons.
		RF2	Behaves like RF1; specific for UGA and UAA codons
		RF3	Stimulates RF1 and RF2.

Folding and Post-translational Processing

In order to achieve its biologically active form, the new polypeptide must fold into its proper **three-dimensional conformation**. Before or after folding, the new polypeptide may undergo **enzymatic processing**, including removal of one or more amino acids (usually from the amino terminus); addition of acetyl, phosphoryl, methyl, carboxyl, or other groups to certain amino acid residues; proteolytic cleavage; and/or attachment of oligosaccharides or prosthetic groups.

On being released from the ribosome, a polypeptide has only **primary structure**. It coils and folds further to have **secondary** and **tertiary structure**. A polypeptide may get associated with other polypeptides to produce **β -pleated structure** which then forms **tertiary** and **quarternary structure**.

Polyribosomes attached to membranes of endoplasmic reticulum produce proteins which either pass into its lumen or become integrated into the membranes. The proteins released into E.R. lumen generally reach **Golgi apparatus** for modifications like formation of **hydrolytic enzyme** and **glycosylation** (addition of sugar residues). The modified proteins are packed in vesicles for export or formation of lysosomes, cell wall enzyme, plasma membrane, etc.

Table : Differences between prokaryotic translation and eukaryotic translation

	Prokaryotic translation	Eukaryotic translation
(i)	It occurs on 70S ribosomes.	It occurs on 80S ribosomes.
(ii)	First amino acid which participates is formyl-Methionine.	First amino acid is Met (methionine).
(iii)	It is a faster process, adds about 20 amino acids per second.	It adds one amino acid per second, thus a slower process.
(iv)	It requires 3 initiation factors IF ₁ , IF ₂ , IF ₃ .	It requires a set of 9 initiation factors.
(v)	After translation formyl group from first formylated methionine is removed, retaining methionine in the polypeptide chain.	The whole of initiating methionine is removed from the polypeptide chain.
(vi)	It requires three release factors RF1, RF2 and RF3 in the termination.	It requires single release factor eRF1.

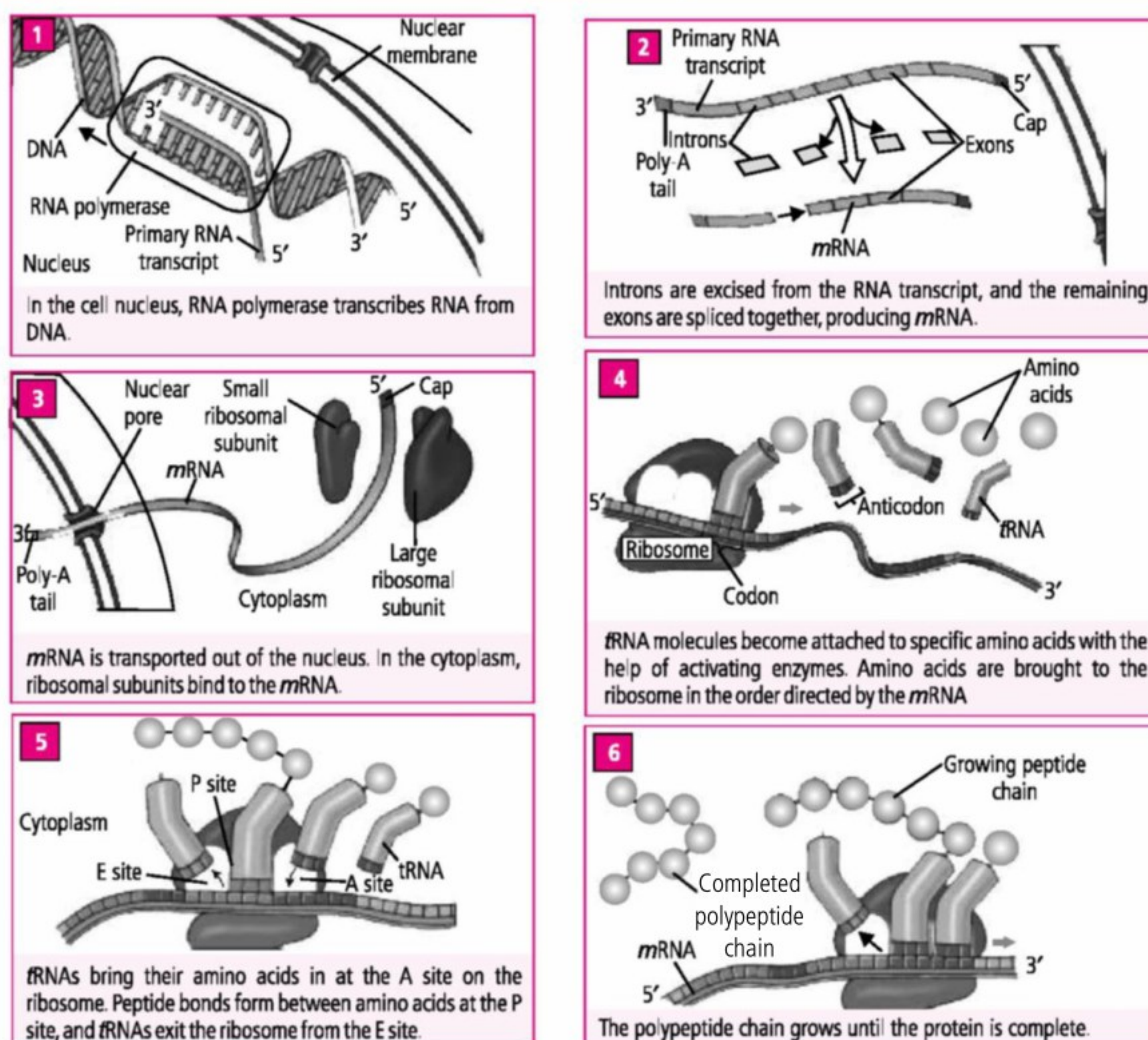


Fig.: Summarized process of transcription and translation

Table : Effects of antibiotics on translation

Antibiotic		Effect
(i)	Puromycin	It has a structure similar to the 3' end of an aminoacyl- <i>t</i> RNA. Thus, binds to the ribosomal A site and participates in peptide bond formation, producing peptidyl-puromycin. However, it does not engage in translocation and quickly dissociates from the ribosome causing a premature termination of polypeptide synthesis.
(ii)	Erythromycin	Prevent elongation of polypeptide chain and inhibits formation of larger subunit.
(iii)	Neomycin	Prevent ribosome assembly by binding to 30s subunit.
(iv)	Streptomycin	Causes misreading of the genetic code in bacteria at relatively low concentrations and inhibits initiation at higher concentrations by binding to the 30S ribosomal subunit.
(v)	Kanamycin	Binds to 30 s subunit of ribosome that result in incorrect alignment with <i>m</i> RNA and cause misreading of the genetic code.
(vi)	Tetracycline	Blocks the A-site on the ribosome, preventing the binding of aminoacyl <i>t</i> RNAs.
(vii)	Chloramphenicol	Blocks the peptidyl transferase and formation of peptide bond on the 50S ribosomal subunit in both bacteria and mitochondria.
(viii)	Diphtheria toxin	Catalyzes the ADP-ribosylation of a diphthamide (a modified histidine) residue of eukaryotic.
(ix)	Ricin	An extremely toxic protein of the castor bean, inactivates the 60S subunit of eukaryotic ribosomes.

POWER EXERCISE

- Given below are the steps of protein synthesis. Arrange them in correct sequence and select the correct option.
 - Codon-anticodon reaction between *m*RNA and aminoacyl *t*RNA complex
 - Attachment of *m*RNA and smaller sub-unit of ribosome.
 - Charging or aminoacylation of *t*RNA
 - Attachment of larger sub-unit of ribosome to the *m*RNA-*t*RNA^{Met} complex
 - Linking of adjacent amino acids
 - Formation of polypeptide chain
 - (ii) → (i) → (iii) → (v) → (iv) → (vi)
 - (v) → (ii) → (i) → (iii) → (iv) → (vi)
 - (iii) → (ii) → (iv) → (i) → (v) → (vi)
 - (iii) → (ii) → (i) → (iv) → (v) → (vi)
- Select the correct statement regarding protein synthesis.
 - When the small subunit of the ribosome encounters an *m*RNA the process of translation begins.
 - Peptidase catalyses the formation of peptide bond.
 - UTRs are present between the start codon and stop codon.
 - At the end of translation, the release factor binds to the initiation codon.
- The differences between *m*RNA and *t*RNA are that
 - m*RNA has more elaborated 3-dimensional structure due to extensive base pairing.
 - t*RNA has more elaborated 3-dimensional structure due to extensive base pairing.
 - t*RNA is usually smaller than *m*RNA.
 - m*RNA bears anticodon but *t*RNA has codons.
 - (i) and (ii)
 - (ii) and (iii)
 - (i), (ii) and (iii)
 - (i), (ii), (iii) and (iv)
- 3' AAATGCGCGATA 5' is the sequence of nucleotides on a gene; after transcription the *m*RNA formed against it and the sequence of bases in the corresponding binding anticodons will be
 - 5'UUUACGCGCUAU3' and 3'AAA-UGC-GCG-AUA5'
 - 5'UAUCGCGCAUUU3' and 3'AUA-GCG-CGU-AAA5'
 - 5'UUUACCTUGUAU3' and 3'AAA-UGG-UAC-AUA5'
 - 5'UAUGUTCCAUUU3' and 3'AUA-CAU-GGU-AAA5'
- During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is that sequence called?
 - AAAT box
 - TATA box
 - GGTT box
 - TAAT box.
- Transcription unit
 - always have palindromic sequence.
 - starts with pallindromic regions and ends with rho factor
 - starts with promotor region and ends in terminator region
 - starts with CAAT region in eukaryotes.

7. **Assertion :** In eukaryotes, both intron and exon are transcribed to form hnRNA.

Reason : Splicing is required in prokaryotes.

- (a) Both assertion and reason are true and reason is the correct explanation of assertion.
 (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
 (c) Assertion is true but reason is false.
 (d) Both assertion and reason are false. (AIIMS 2019)

8. Select the correct statement.

- (a) mRNA is polycistronic in eukaryotes and monocistronic in prokaryotes
 (b) mRNA is polycistronic in prokaryotes and monocistronic in eukaryotes
 (c) mRNA is polycistronic in both eukaryotes and prokaryotes
 (d) mRNA is monocistronic in both eukaryotes and prokaryotes

9. Which part of RNA polymerase enzyme recognises promoter region?

- (a) σ (b) $\alpha_2\beta$ (c) β' (d) $\alpha\alpha_1$.

10. DNA-dependent RNA polymerase catalyses transcription on one strand of the DNA which is called the

- (a) template strand (b) coding strand
 (c) alpha strand (d) antistrand.

(NEET Phase - II 2016)

11. In eukaryotic cell transcription, RNA splicing and RNA capping take place inside

- (a) ribosomes (b) nucleus
 (c) dictyosomes (d) endoplasmic reticulum.

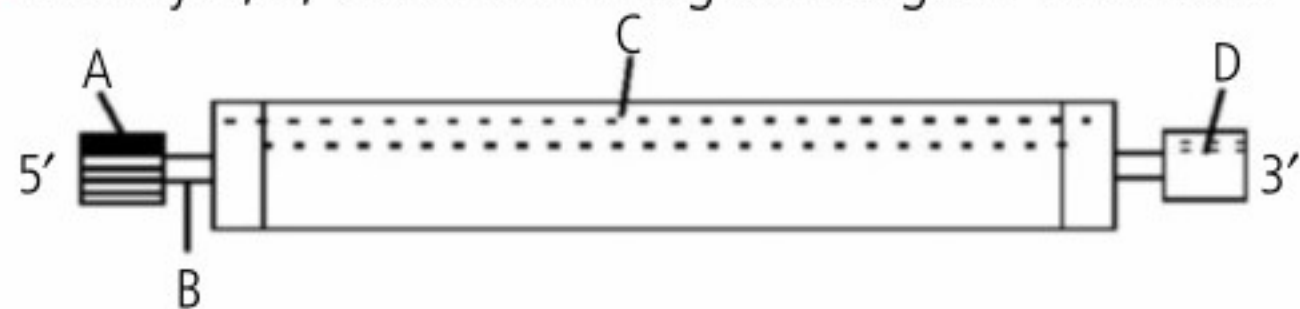
12. Which one of the following processes occurs inside the nucleus during protein synthesis in a eukaryotic cell?

- (a) Processing of hnRNA (b) Activation of amino acids
 (c) Translation
 (d) Formation of polypeptide chain

13. Which of the following statements are correct?

- (i) RNA polymerase I transcribes rRNAs.
 (ii) RNA polymerase II transcribes snRNAs.
 (iii) RNA polymerase III transcribes hnRNA.
 (iv) RNA polymerase II transcribes hnRNA.
 (a) (i) and (ii) are correct (b) (i) and (iii) are correct
 (c) (i), (ii) and (iv) are correct
 (d) (i) and (iv) are correct

14. Identify A, B, C and D in the given diagram of mRNA.



	A	B	C	D
(a)	Methylated cap	Initiation codon	Termination codon	Poly A tail
(b)	Poly A tail	Termination codon	Initiation codon	Methylated cap
(c)	Methylated cap	Non-coding region	Coding region	Poly A tail
(d)	Methylated cap	Coding region	Non-coding region	Poly A tail

15. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA?

- (a) AGGUAUCGCAU (b) UGGTUTCGCAT
 (c) ACCUAUGCGAU (d) UCCAUAAGCGUA

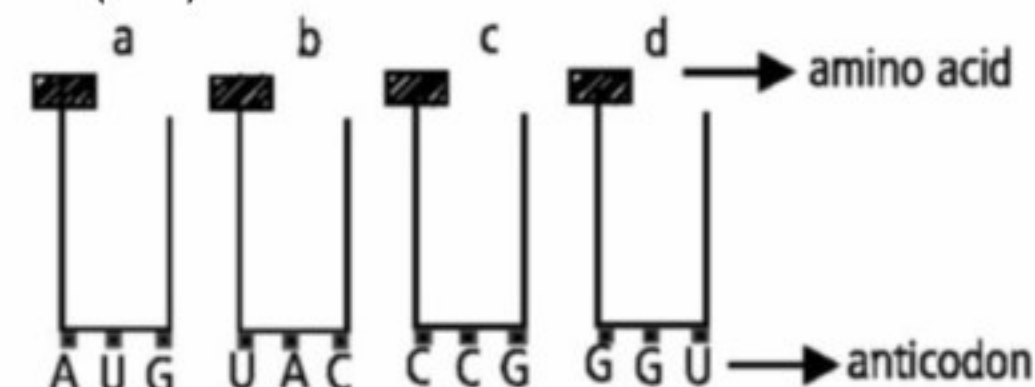
(NEET 2018)

16. In protein synthesis, the polymerisation of amino acids involves three steps. Which one of the following is not involved in the polymerisation of protein ?

- (a) Termination (b) Initiation
 (c) Elongation (d) Transcription

17. Find the sequence of binding of the following amino acyl-tRNA complexes during translation of a mRNA transcribed by a DNA segment having the base sequence 3' TACATGGGTCCG 5'. Choose the answer showing the correct order of alphabets (a-d).

- (a) a, b, d, c
 (b) b, a, d, c
 (c) a, b, c, d
 (d) b, a, c, d



18. **Assertion :** In eukaryotes, replication and transcription occur in the nucleus but translation occurs in the cytoplasm.

Reason : mRNA is transferred from the nucleus to the cytoplasm where ribosomes and amino acids are available for protein synthesis.

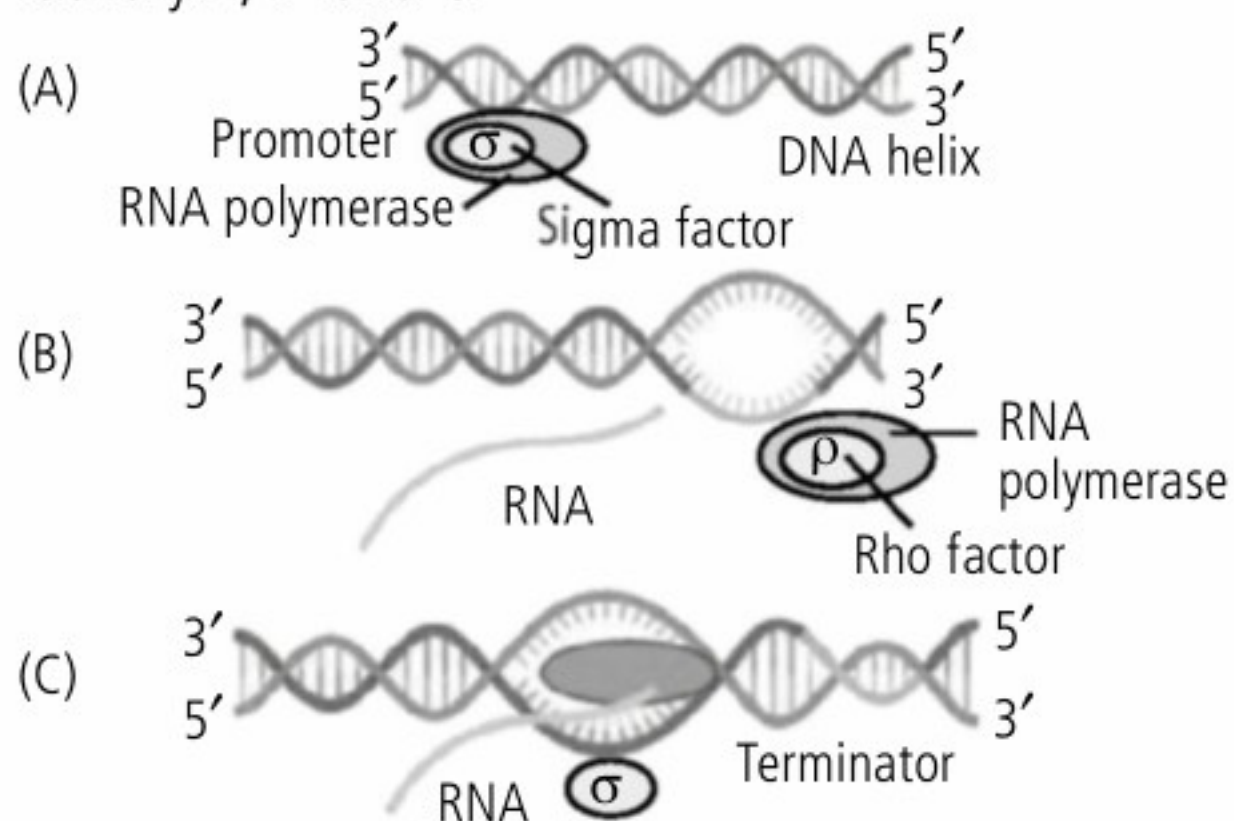
- (a) Assertion is true but reason is false.
 (b) Assertion is false but reason is true.
 (c) Both assertion and reason are false.
 (d) Both assertion and reason are true but reason is not the correct explanation for assertion.
 (e) Both assertion and reason are true and reason is the correct explanation for assertion. (Kerala PMT 2016)

19. During transcription, mRNA provide ...A..., tRNA brings ...B... and reads genetic code and rRNAs play ...C... and catalytic role during ...D....

Choose the correct option for A, B, C and D.

- (a) A-template, B-amino acid, C-structural, D-translation
 (b) A-template, B-nucleotides, C-structural, D-translation
 (c) A-template, B-nucleotides, C-structural, D-translation
 (d) A-template, B-amino acid, C-functional, D-transcription

20. Identify A, B and C.



- (a) (A) Elongation, (B) Termination, (C) Initiation
 (b) (A) Initiation, (B) Termination, (C) Elongation
 (c) (A) Initiation, (B) Elongation, (C) Termination
 (d) (A) Termination, (B) Elongation, (C) Initiation

(AIIMS, 2019)

ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (d) | 2. (a) | 3. (b) | 4. (a) | 5. (d) |
| 6. (c) | 7. (c) | 8. (b) | 9. (a) | 10. (a) |
| 11. (b) | 12. (a) | 13. (d) | 14. (c) | 15. (a) |
| 16. (d) | 17. (b) | 18. (e) | 19. (a) | 20. (b) |



Let's Talk About...



Were you headed for the bar?

Come on, this is serious stuff. These geese can fly as high as 26,000 feet.

Whoa! That's nearly as high as Mount Everest.

Precisely. Everest climbers often observe the bar-headed geese flying over other slightly lower peaks.

Where do they go?

They are migratory birds they travel from as far north as Mongolia to the Indian sea shores and back.

Tough birds, these geese...

Yes. You see, at those heights, oxygen level is often at 30-35% of normal.

And mountaineers have to carry oxygen to reach such heights.

You must then wonder how these birds manage in such low oxygen.

BAR-HEADED GEESE

PEOPLE, PLACES AND THINGS BEYOND HEADLINES



uses less oxygen. Also, they manage to let the temperature of their blood drop a bit.

They turn cold blooded?

No, no... just two degrees below their normal. See,

haemoglobin is able to carry more oxygen at lower temperatures.

How did the geese get this ability?

The scientists think it has evolved over millions of years. As the Himalayas grew taller, the birds became more efficient.

So less makes you more efficient?

Not me. The geese....

Well as they say, what's good for the goose is good for the gander!

I guess that's what you are trying to tell me.

A group of scientists have tested the geese, making them fly in air tunnels with low oxygen. They have just published their research.

Don't tell me they breathe nitrogen.

Now, that would be a bit radical. But the bar headed geese actually becomes more efficient user of oxygen in this environment.

How is that possible?

First thing, they slow down their metabolism at these heights. Their wing strokes also change in a manner that

Courtesy : The Economic Times

THE DYING AMAZON

For many years we have brought so much damage to our planet that now we have to battle against the consequences of our own greed. There's no dreadful sight in nature than a burning forest. The rainforest is supposed to be green, wet and cool, not having burnt trees and dead animals covered with smoke and fume. But in the new world of climate change that we inhabit, a burning forest seems to be the probable outcome. Report shows the global wildfire becomes epidemic in the past three years and recently, the entire world has focussed on Amazon rainforest fire incident.

The Amazon basin, popularly known as Amazon rainforest, occupies 40% area of South America and is home to 1 out of 10 of the world's known animal species. According to the World Wildlife Fund (WWF), it contains 1.4 billion acres of dense forest. This species-rich biome constitutes the largest collection of living plants and animal species in the world. However, since 1970s, 800,000 sq. km of the Amazon forest have been lost to the development projects like farming, dams, logging and road building. Chunks of the Amazon, are being cleared every day to make places like football fields. As a result, a year-to-year surge in fires has been evident in the Amazon rainforest within Brazil, Bolivia, Paraguay, and Peru during Amazonian tropical dry season (from June to December). The increased rates of forest fires were first reported by Brazil's National Institute for Space Research in June and July 2019 through satellite monitoring systems, but international attention was drawn to the situation by August 2019 when NASA share their findings as the smoke

from the fires was clearly visible in satellite imagery. Reports say, there have been more than 80,000 fires so far this year which is a nearly 80 percent high as compared to the number

of fires the country experienced over the same time period in 2018. Smoke from the fires got so bad that it seemed to turn day into night in Sao Paulo on August 20th. Residents say, the air quality is still making it difficult to breathe. The fires have been releasing a large amount of carbon dioxide,

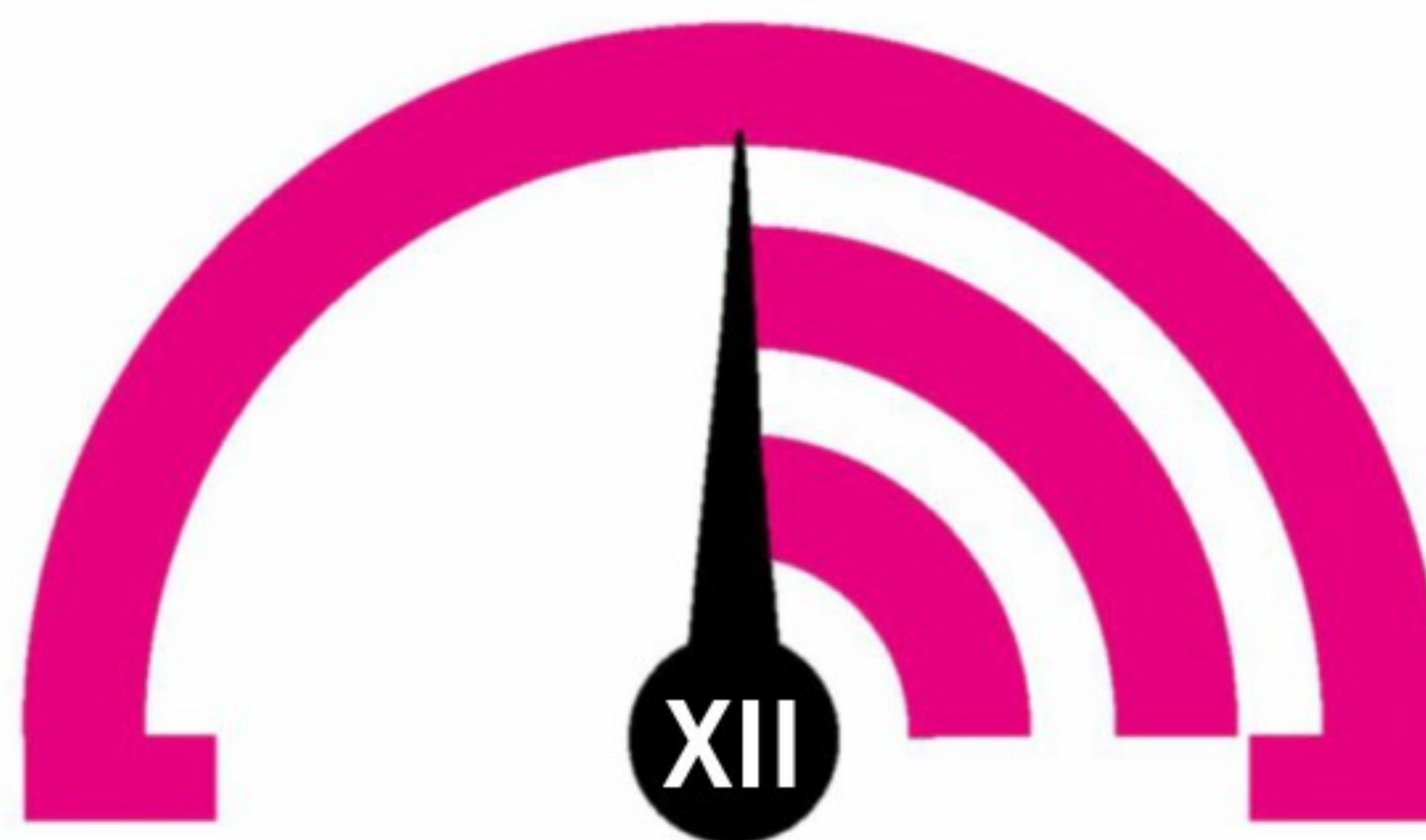
the equivalent of 228 mega tonnes so far this year (BBC report). They are also emitting carbon monoxide - the gas released from incomplete combustion of wood.

Now, the question we are facing is about the forthcoming effects of this expansive catastrophe. Apart from the oxygen production, Amazon acts as the global carbon dioxide sink. Expert says, "the rainforest absorbs about 15% of the carbon dioxide in the atmosphere. This is really fundamental because if it didn't exist, this carbon dioxide would remain in the atmosphere and climate would change at a faster pace". Moreover, we should not forget, it is the home for those thousands of animals, majority of whom we have lost in

this incident for our sin. The day is not far, when we have to pay heavily for these intentional deforestations on global scale.

◆◆◆

MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Series 5: • Evolution

Total Marks : 160

Time Taken : 40 Min.

• Human Health and Disease

- Populations are said to be allopatric when
 - they are physically isolated by natural barriers
 - they share the same area but cannot interbreed
 - they live together and breed freely to produce viable offspring
 - they are isolated but often come together for breeding.
- An isolated population of humans with approximately equal number of blue-eyed and brown-eyed individuals was decimated by an earthquake. Only a few brown-eyed people remained to form the next generation. This kind of change in the gene pool is called a
 - Hardy-Weinberg equilibrium
 - blocked gene flow
 - bottleneck effect
 - founder effect.
- Which of the following statement is true about amoebiasis causing organism?
 - It is caused by virus.
 - It is acquired through food contaminated with cysts.
 - It occurs in a single form.
 - It is digenetic.
- Refer to the given statements and select the option that correctly fill the blanks.
 - In (i) and (ii), the immune system starts destroying body's own proteins.
 - (iii) is the malignant growth of tissues derived from primitive mesoderm.
 - (iv) was the first drug used for the treatment of AIDS.

(i)	(ii)	(iii)	(iv)
(a) diabetes mellitus	Hashimoto's thyroiditis	Sarcoma	Zidovudine
(b) rheumatic fever	SCID	Carcinoma	Azidothymidine
(c) cancer	AIDS	Sarcoma	Didanosine
(d) Addison's disease	rheumatoid arthritis	Carcinoma	Didanosine

- Match column I with column II and select the correct option.

Column I

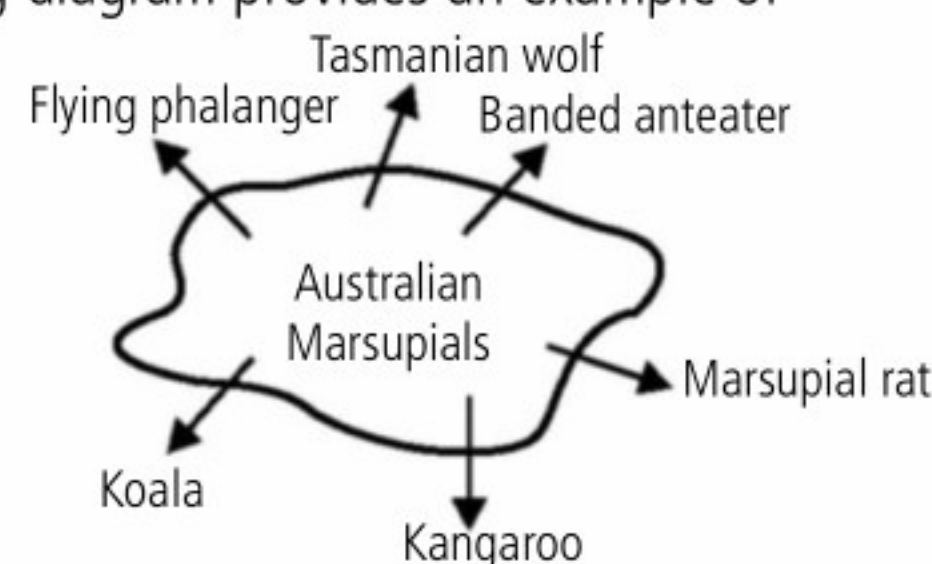
- P. vivax*
- P. falciparum*
- P. malariae*
- P. ovale*

Column II

- Maurer's dots
- Jame's dots
- Schuffner's dots
- Ziemann's dots

- (i)-R; (ii)-P; (iii)-S; (iv)-Q
- (i)-R; (ii)-S; (iii)-Q; (iv)-P
- (i)-P; (ii)-Q; (iii)-R; (iv)-S
- (i)-P; (ii)-S; (iii)-R; (iv)-Q

- Following diagram provides an example of



- convergent evolution
- parallel evolution
- recapitulation
- divergent evolution.

- Select the correct sequence of events in the origin of life?
 - Formation of protobionts
 - Synthesis of organic monomers
 - Synthesis of organic polymers
 - Formation of DNA-based genetic systems

WHO AM I ...

- | | |
|----------------|--------|
| 1. Plasmolysis | Pg. 12 |
| 2. Copper | Pg. 17 |
| 3. IgA | Pg. 50 |
| 4. Histamine | Pg. 53 |

- (a) I, II, III, IV (b) I, III, II, IV
(c) II, III, I, IV (d) II, III, IV, I

8. Which one of the following is correct about the characteristics of protobionts (coacervates and microspheres) as envisaged in the abiogenic origin of life?

- (a) They were partially isolated from the surroundings.
(b) They could maintain an internal environment.
(c) They could selectively uptake material from the surroundings.
(d) All of these.

9. Read the given statements and select the option correctly stating which ones are true (T) and which ones are false (F).

- I. BCG vaccine gives protection against tuberculosis.
II. *Entamoeba histolytica* resides in jejunum and ileum parts of the small intestine and is more common in females than males.
III. Man is the primary host whereas sheep is the secondary host in life cycle of *Ascaris lumbricoides*.
IV. Chemical formula of caffeine is $C_8H_{10}N_4O_2$.

- | | I | II | III | IV |
|-----|---|----|-----|----|
| (a) | T | F | F | F |
| (b) | T | F | F | T |
| (c) | F | T | F | T |
| (d) | F | T | T | T |

10. Find the incorrect statement about Hardy-Weinberg principle.

- (a) The frequency of alleles in a population are stable and constant from generation to generation.
(b) The gene pool of a population varies from generation to generation.
(c) In a population sum total of all the allelic frequencies is one.
(d) All of these

11. Given: 1 = natural selection; 2 = Favourable variations and their inheritance; 3 = survival of the fittest; 4 = struggle for existence. According to Darwinism, which of the following represents the correct sequence of events in the origin of new species ?

- (a) 3, 4, 1, 2 (b) 2, 3, 1, 4
(c) 1, 2, 3, 4 (d) 4, 2, 1, 3

12. Fill up the blanks.

_____ is a CNS stimulant as it interferes with the transport of the neuro-transmitter _____.

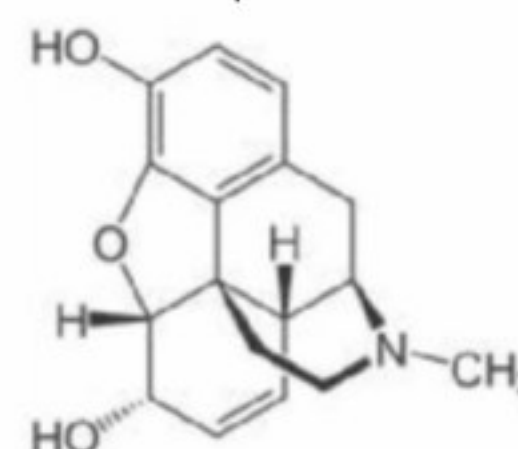
- (a) Cocaine, acetylcholine (b) Barbiturate, glutamate
(c) Cocaine, dopamine (d) Barbiturate, glycine.

13. In the case of peppered moth (*Biston betularia*) the black-coloured form became dominant over the light-coloured form in England during industrial revolution. This is an example of

- (a) appearance of the darker coloured individuals due to very poor sunlight
(b) protective mimicry

- (c) inheritance of darker colour character acquired due to the darker environment
(d) natural selection whereby the darker forms were selected

14. The chemical compound whose chemical structure is given below is obtained from which plant?



- (a) *Papaver somniferum*
(b) *Erythroxylum coca*
(c) *Atropa belladonna*
(d) *Cannabis sativa*

15. Select the correct statement with respect to diseases and immunisation.

- (a) If due to some reason B and T lymphocytes are damaged, then the body will not produce antibodies against a pathogen.
(b) Injection of dead or inactivated pathogens causes passive immunity.
(c) Certain protozoans have been used in mass production of hepatitis B vaccine.
(d) Injection of snake antivenom against snake bite is an example of active immunisation.

16. Which of these sets is correct?

- (a) *Plasmodium falciparum*, quartan malaria, relapse, mosquito
(b) *Trypanosoma gambiense*, *Glossina*, sleeping sickness, winterbottom's sign
(c) *Wuchereria bancrofti*, elephantiasis, rhabditiform larva, mosquito
(d) *Entamoeba histolytica*, dysentery, binucleate cyst, colon

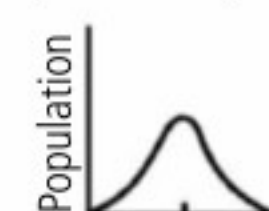
17. Which out of the following groups represent immune disorders?

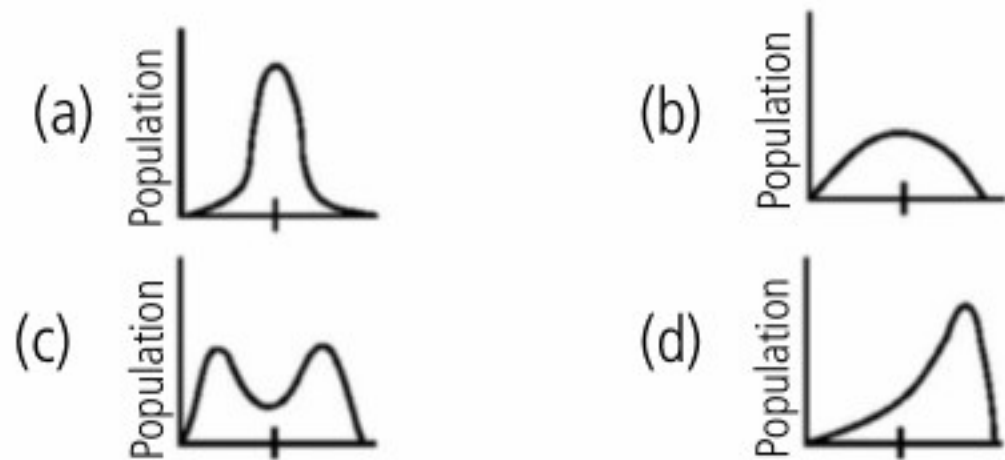
- (a) SCID and diphtheria (b) SCID and AIDS
(c) AIDS and cholera (d) Hepatitis and leukaemia

18. Where does the sexual stage (gametocytes) of *Plasmodium* form?

- (a) Salivary glands of mosquito
(b) Human RBC
(c) Intestine of mosquito
(d) Human liver

19. The given graph shows the range of variation among population members for a trait determined by multiple genes. If this population is subjected to disruptive selection for several generations, which of the following distributions is most likely to result?





20. The theory which states that life reached earth from some unknown part of the universe in the form of spores is known as ____ (i) _____. It was proposed by ____ (ii) _____.

(i)

- (a) cosmozoic theory
(b) biogenesis theory
(c) theory of panspermia
(d) naturalistic theory

(ii)

- Georges Cuvier
Preyer
Richter
Preyer

21. Match the following and select the correct option from the given codes.

Column I

1. Mesozoic
2. Devonian
3. Palaeocene
4. Oligocene

Column II

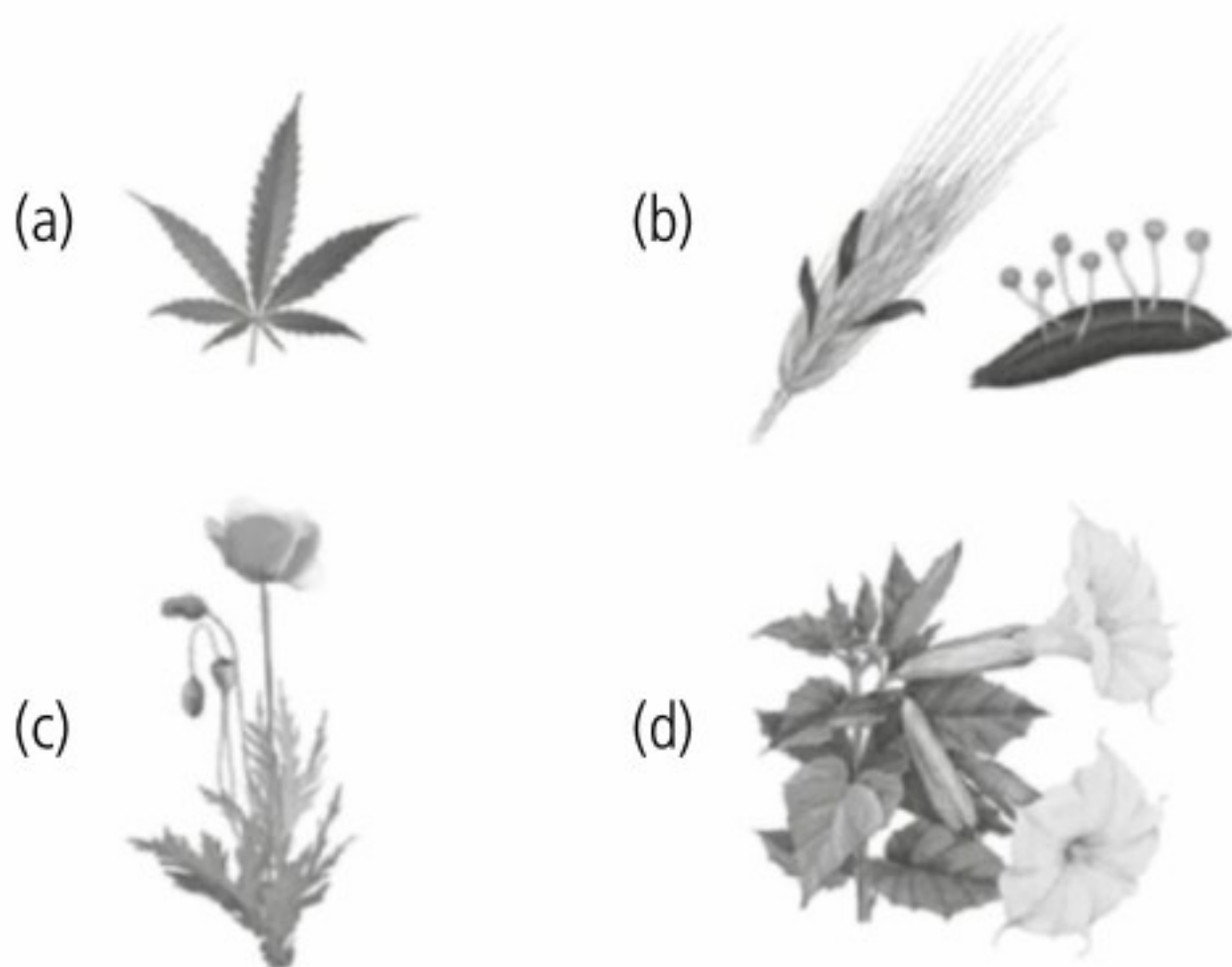
- (i) First amphibians
(ii) Rise of first monkey and apes
(iii) Extinction of dinosaurs
(iv) Rise of first primates

- (a) 1-(i), 2-(iv), 3-(iii), 4-(ii)
(b) 1-(iii), 2-(i), 3-(iv), 4-(ii)
(c) 1-(iv), 2-(i), 3-(ii), 4-(iii)
(d) 1-(ii), 2-(i), 3-(iv), 4-(iii)

22. A person suffering from a disease caused by *Plasmodium*, experiences recurring chill and fever at the time when?

- (a) The sporozoites released from RBCs are being rapidly killed and broken down inside spleen
(b) The trophozoites reach maximum growth and give out certain toxins
(c) The parasite after its rapid multiplication inside RBCs ruptures them and releasing new parasites to enter fresh RBCs
(d) The microgametocytes and megagametocytes are being destroyed by the WBCs.

23. Which of the following is a source for psychotropic drug?



24. Darwin in his "Theory of Natural Selection" did not believe in any role of which one of the following in organic evolution?

- (a) Parasites and predators as natural enemies
(b) Survival of the fittest
(c) Struggle for existence
(d) Discontinuous variations

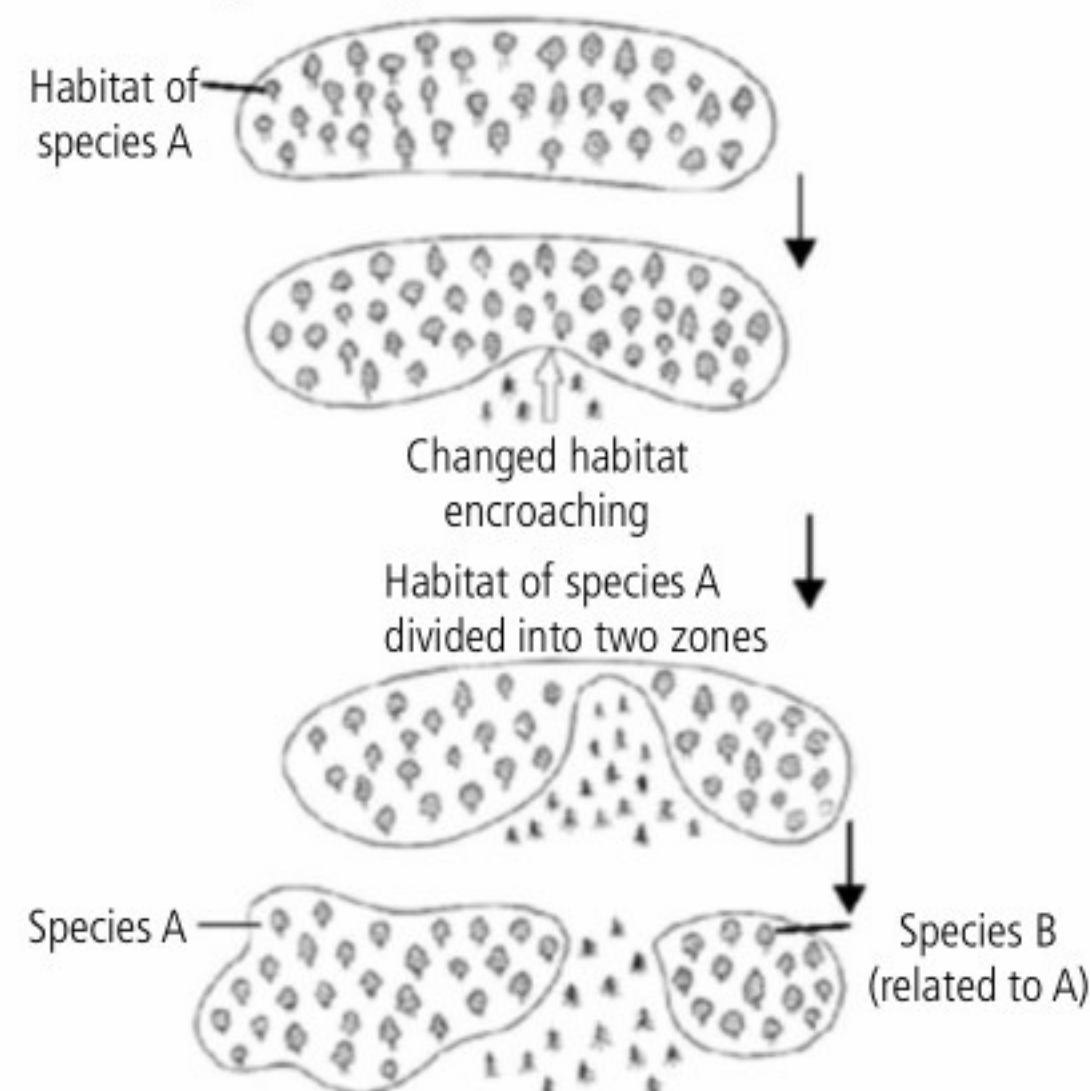
25. Select the correct the statements regarding the characteristics of acquired immunity.

- (i) Cell-mediated immunity is responsible for acquired immunity.
(ii) It produces a primary response of low intensity.
(iii) Active and passive immunity are types of acquired immunity.
(iv) Polymorphonuclear leukocytes and natural killer cells are involved in acquired immunity.

The correct statements are:

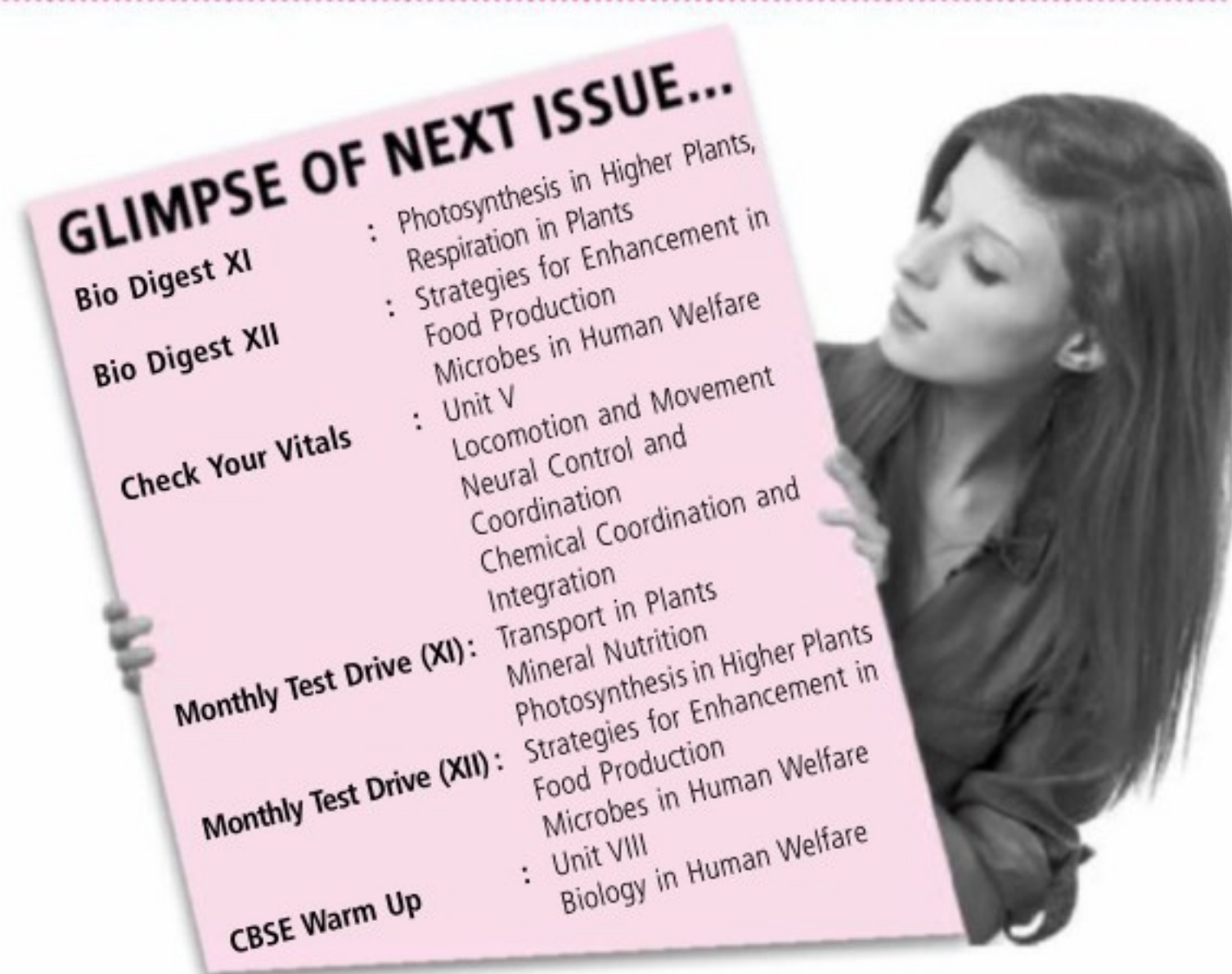
- (a) (i), (ii) and (iii) (b) (i), (iii) and (iv)
(c) (i) and (iv) (d) (i) and (iii)

26. Refer to the given figure.



It illustrates an example of

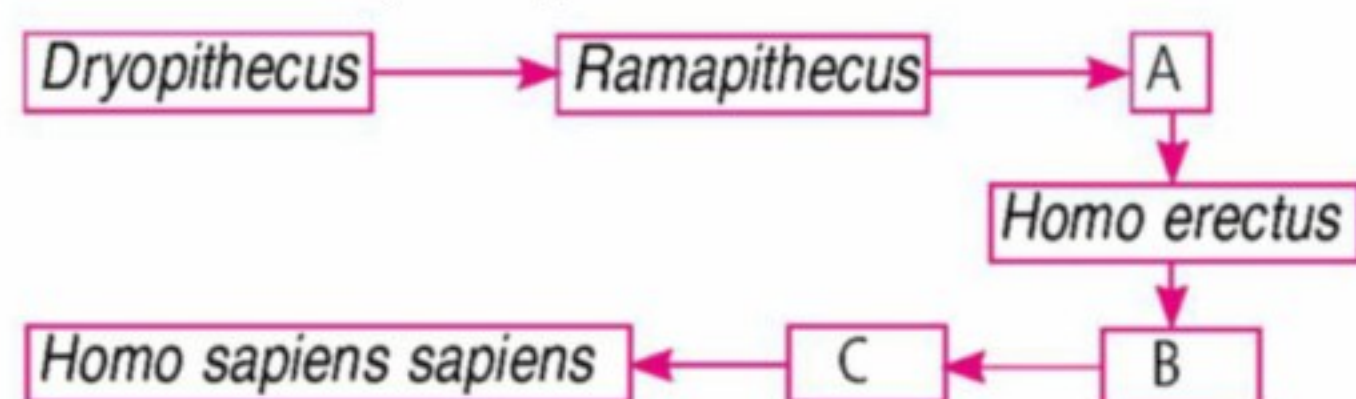
- (a) sympatric speciation (b) allopatric speciation
(c) parapatric speciation (d) none of these.



27. Select the option that correctly fills any four blanks in the given paragraph.

The primary lymphoid organs are bone marrow and _____. The _____ mature in the bone marrow and migrate to secondary lymphoid organs *via* blood and _____. Here they undergo proliferation and _____. T-lymphocytes help B-lymphocytes to produce _____ which regulate _____ immunity.

- (a) (i) thymus, (iii) lymph, (iv) differentiation, (vi) humoral
 (b) (i) spleen, (ii) B-lymphocytes, (iv) activation, (v) immunoglobulins
 (c) (i) thymus, (iii) interstitial fluid, (iv) perforins, (vi) humoral
 (d) (i) lymph nodes, (ii) T-lymphocytes, (v) antibodies, (vi) cellular
28. What is the correct arrangement of periods of palaeozoic era in geological time scale in ascending order?
- (a) Cambrian → Devonian → Ordovician → Silurian → Carboniferous → Permian
 (b) Cambrian → Ordovician → Silurian → Devonian → Carboniferous → Permian
 (c) Cambrian → Ordovician → Devonian → Silurian → Carboniferous → Permian
 (d) Silurian → Devonian → Cambrian → Ordovician → Permian → Carboniferous
29. Given flow chart shows the chronological order of evolution of human from early to recent. Identify the missing links A, B and C from options given below.



- (a) A – *Homo habilis*, B – *Australopithecus*, C – Cro-magnon man
 (b) A – *Australopithecus*, B – Neanderthal man, C – *Homo habilis*
 (c) A – *Homo habilis*, B – Cro-magnon man, C – *Homo sapiens fossilis*
 (d) A – *Australopithecus*, B – Neanderthal man, C – Cro-magnon man
30. Read the given statements and select the correct option.
- Statement A :** Chronic alcoholism can lead to cirrhosis.
Statement B : Continuous intake of alcohol leads to hepatocyte destruction and collagen deposition in liver.
- (a) Both statements A and B are correct and B is the correct explanation of A.

- (b) Both statements A and B are correct but B is not the correct explanation of A.
 (c) Statement A is correct but B is incorrect.
 (d) Both statements A and B are incorrect.

31. Which one of the following options gives the correct matching of a disease with its causative organism and mode of infection?

Disease	Causative organism	Mode of infection
(a) Typhoid	<i>Salmonella typhi</i>	With inspired air
(b) Pneumonia	<i>Streptococcus pneumoniae</i>	Droplet infection
(c) Elephantiasis	<i>Wuchereria bancrofti</i>	With infected water and food
(d) Malaria	<i>Plasmodium vivax</i>	Bite of male <i>Anopheles</i> mosquito.

32. **Statement A :** Old world monkeys are close to man.
Statement B : They have better developed brain, smaller ear pinnae and sensitive finger tips.
- (a) Both statements A and B are correct and statement B is the correct explanation of statement A.
 (b) Both statements A and B are correct but statement B is not the correct explanation of statement A.
 (c) Statement A is correct but statement B is incorrect.
 (d) Both statements A and B are incorrect.



NEET 2020 DATE SHEET RELEASED

The entrance exam for the MBBS/BDS courses in India — National Eligibility cum Entrance Test (NEET) for undergraduate courses is going to be held on **May 3, 2020 (Sunday)**. This is the second time the National Testing Agency (NTA) will be conducting the NEET. The application process will begin from December 2 and will close on December 31. Interested candidates can apply at ntaneet.nic.in.

All those candidates who have passed class 12 are eligible to appear for the National Eligibility Entrance Test (NEET UG 2020). The exam will be held in the pen-and-paper mode and from **March 27**, the applicants can download the **NEET admit card**. The result for NEET is scheduled to release on **June 4**.

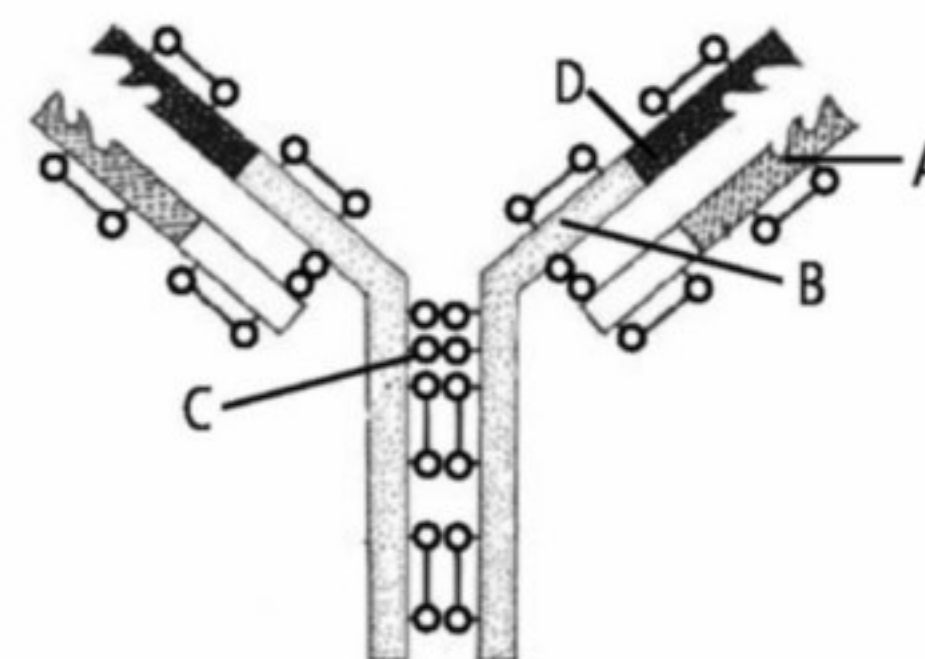
NEET is a three-hour long exam which includes three sections — physics, chemistry and biology. Of the total 180 questions, 90 would be from biology and 45 each from physics and chemistry. Preparation syllabus includes the whole of class 11 and 12 standard NCERT textbooks in the respective subjects.

Every correct answer would get plus four marks and every incorrect answer result in a negative mark. Questions that are not attempted do not have any penalty marks. The National Testing Agency (NTA) has been set-up by the government of India responsibility of NTA to conduct the entrance test. Competitive entrance exams including NEET UG, JEE, NET, etc. were earlier conducted by CBSE. In NEET 2019, record 15 lakh candidates applied and the exam was held on May 5.

33. Fossils are
 (a) preserved hard parts of organisms in rock layers only
 (b) prints of organisms of remote past in layer of rocks
 (c) mineralised part of past organisms
 (d) all of these.
34. Which one of the following phenomena supports Darwin's concept of natural selection in organic evolution?
 (a) development of transgenic animals
 (b) production of 'Dolly', the sheep by cloning
 (c) prevalence of pesticide resistant insects
 (d) development of organs from 'stem cells' for organ transplantation.
35. Select the correct option with the name of the drug yielding plant with their family and drug yielding part.
- | Plant | Family | Drug-yielding part |
|-------------------------------|-----------|--------------------|
| (a) <i>Cannabis indica</i> | Moraceae | Dried seeds |
| (b) <i>Papaver somniferum</i> | Theaceae | Dried leaves |
| (c) <i>Coffea arabica</i> | Rubiaceae | Dried seeds |
| (d) <i>Claviceps purpurea</i> | Cactaceae | Fruiting bodies |
36. Select the mismatched pair.
 (a) Alcoholism – Mallory Weiss Syndrome, Pancreatitis
 (b) Toxoid – Tetanus vaccine, Diphtheria vaccine
 (c) Analogous organs – Thorn of *Bougainvillea*, Tendril of *Cucurbita*.
 (d) Missing link – *Seymouria*, *Ichthyostega*
37. Read the following statements and select the correct option.
 (i) Allergy is the hyposensitive response of a person to some foreign particles entering into the body.
 (ii) Tonsil is a bean shaped organ which produces lymphocytes.
 (iii) Antigen binds to a macrophage to reach a helper T-cell to initiate immune response.
 (iv) IgM has a J chain and its each dimer contains secretory component.
 (a) (i) only (b) (i), (ii) and (iv) only
 (c) (ii) and (iv) only
 (d) (iii) and (iv) only
38. Read the following postulates regarding a theory of evolution and identify the scientist who gave them.
 I. Discontinuous variations are the raw material of evolution.

- II. Accumulation of variations produce a new species.
 III. Evolution is a discontinuous process.
 (a) Hugo de Vries
 (b) Alfred Wallace
 (c) Lamarck
 (d) Darwin

39. Identify the correct labellings of the given diagram.



- (a) A-Constant region of light chain; B-Variable region of heavy chain; C-Disulphide bond; D-Constant region of heavy chain.
 (b) A-Variable region of heavy chain; B-Constant region of light chain; C-Hydrogen bond; D-Variable region of light chain
 (c) A-Variable region of light chain; B-Constant region of heavy chain; C-Hydrogen bond; D-Variable region of heavy chain
 (d) A-Variable region of light chain; B-Constant region of heavy chain; C-Disulphide bond; D-Variable region of heavy chain
40. Given below are four statements (i) – (iv) regarding geological time scale.
 (i) Palaeozoic era is the era of ancient life.
 (ii) Ordovician period is the age of vertebrates.
 (iii) Carboniferous period is the age of reptiles.
 (iv) Proterozoic era is the era of early life.
 Which of the above two statements are correct?
 (a) (i) and (iv)
 (b) (ii) and (iii)
 (c) (ii) and (iv)
 (d) (i) and (iii)



Key is published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted
 No. of questions correct
 Marks scored in percentage

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

FIELD NOTE

Indian Vulture

Scientific Name : *Gyps indicus*

Population : 30,000 (Global)

IUCN Red List Status : Critically
Endangered

Population Trend : Decreasing

Nest

Gyps indicus also called long-billed vultures are found in south-east Pakistan and peninsular India. The species was also recorded in Nepal for the first time in 2011. It is found in cities, towns and villages near cultivated areas, and in open and wooded areas. It nests almost exclusively in colonies on cliffs and ruins, although where cliffs are absent, it has been reported nesting in trees.

Features

Robust and scruffy with eagle-like bearing. Usually 80-103 cm long and wing span 1.96-2.38 m. Adults have a black head, pale eye rings, pale yellow bill, a sturdy black neck and a large white neck ruff. Feathers on the back and upper wings are brown fading to cream on the underside, and pale on thighs. Juveniles have blackish bills, pinkish head and neck covered in pale down feathers, feathery neck ruff, and heavily feathered thighs.

Diet

Carnivore. Like other vultures, feeds almost entirely on carrion (decaying flesh of dead animals). Often associates with White-rumped vultures (*Gyps bengalensis*) while scavenging at rubbish dumps and slaughterhouses.

Breeding

The breeding season for *Gyps indicus* is from October to May/June and, despite being a priority species for conservation, relatively little is known about their breeding and nesting ecology.

Threats

By mid-2000, large number of *Gyps* vultures died due to intake of anti-inflammatory drug diclofenac, that was used to treat domestic livestock. A second veterinary drug ketoprofen, has also been identified to be lethal to the species. Other likely contributory factors are changes in human consumption and processing of dead livestock, poison and pesticide use, but these are probably of minor significance. But we should know that other drugs (aceclofenac, carprofen, flunixin, ketoprofen and nimesulide) are also toxic and their threat is arguably far greater than diclofenac, because they are all still legal.

INTERESTING FACTS

- Vultures can eat up to 20% of their body weight in one sitting.
- It is believed that they are able to spot a carcass from four miles away on the open plains.
- Vultures urinate on itself in order to cool down when temperatures reach blistering highs.
- Extremely strong acids inside the vulture's stomach help to break down the bones of the carcasses that the birds devour. These also kill the germs taken with rotten food.

Protection

The Indian government has now passed a bill banning the manufacture of the veterinary drug diclofenac and thereby stop its misuse in livestock. A suitable alternative meloxicam, have now been developed, that has no ill-effects on *Gyps* vulture. Captive breeding efforts are ongoing. Conservation activities include meeting key groups (e.g., pharmacists, veterinarians and livestock owners); engaging government officials with public for awareness at tehsil, district and state levels, national and international ecotourism to feeding sites and conservation breeding sites.

Please send your feedback for our new article by mail at editor@mtg.in



The questionnaire contains multiple choice questions from different topics covered in this issue for effective recapitulation.

- Select the incorrect statement.
 - Calcium, magnesium and sulphur are macronutrients.
 - Iron, chlorine and manganese are micronutrients.
 - Phosphorus, potassium and iron are considered as non-mineral elements.
 - Critical concentration is that limited concentration of the essential element below which growth of the plant is reduced.
- Match the column I and II and select the correct option from given codes.

Column I (Test)	Column II (Disease)
A. Widal test	(i) Tuberculosis
B. Dick test	(ii) Diphtheria
C. Schick test	(iii) Scarlet fever
D. Mantoux test	(iv) Typhoid

 - A-(i), B-(iii), C-(iv), D-(ii)
 - A-(iv), B-(iii), C-(ii), D-(i)
 - A-(iii), B-(iv), C-(ii), D-(i)
 - A-(iv), B-(ii), C-(iii), D-(i)
- Rheumatoid arthritis that occurs in younger people is known as
 - osteoarthritis
 - infectious arthritis
 - gouty arthritis
 - Still's disease.
- Read the given statements and select the incorrect one.
 - Queen bee is fertile female and lays eggs.
 - Workers are sterile females and perform duties of the colony.
 - The worker bees are biggest members of the colony.
 - Drones are males which mate with bees and are produced by parthenogenesis.
- Deplasmolysis is carried out by placing the plasmolysed cell in
 - saturated solution
 - water
 - isotonic solution
 - hypertonic solution.
- Which of the following pair of minerals is involved in water splitting reaction during photosynthesis?
 - Magnesium and Chlorine
 - Potassium and Manganese
 - Manganese and Chlorine
 - Molybdenum and Manganese
- A plant showed stunted growth, leaves dull green or with purple and red spots of anthocyanins, premature fall of flower buds and chlorosis with necrosis first in older leaves. This could be due to deficiency of
 - potassium
 - phosphorus
 - iron
 - manganese.
- Select the mismatched pair.
 - Nostoc* - Free living N_2 fixing cyanobacteria
 - Frankia* - Free living N_2 fixing bacteria
 - Beijerinckia* - Free living N_2 fixing bacteria
 - Aulosira* - Free living N_2 fixing cyanobacteria
- Opium is obtained from
 - Papaver somniferum*
 - Cannabis sativa*
 - Erythroxylon coca*
 - Claviceps purpurea*.
- Mohit has got fungal infection on skin and hair but not on the nails. He might be infected by
 - Microsporum*
 - Epidermophyton*
 - Trichophyton*
 - Tinea pedis*.

Monthly Test Drive-5 CLASS XII ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (a) | 2. (c) | 3. (b) | 4. (a) | 5. (a) |
| 6. (d) | 7. (c) | 8. (d) | 9. (b) | 10. (b) |
| 11. (d) | 12. (c) | 13. (d) | 14. (a) | 15. (a) |
| 16. (b) | 17. (b) | 18. (b) | 19. (c) | 20. (c) |
| 21. (b) | 22. (c) | 23. (c) | 24. (d) | 25. (a) |
| 26. (b) | 27. (a) | 28. (b) | 29. (d) | 30. (a) |
| 31. (b) | 32. (a) | 33. (d) | 34. (c) | 35. (c) |
| 36. (c) | 37. (d) | 38. (a) | 39. (d) | 40. (a) |

11. Diffusion rate will increase when
 (a) both density of the medium and temperature is decreased.
 (b) density of medium is decreased and temperature is increased.
 (c) both density of medium and temperature is increased.
 (d) density of medium is increased and temperature is decreased.
12. Which of the following processes require the energy expenditure?
 (a) Osmosis (b) Diffusion
 (c) Active transport (d) Passive transport
13. Karan Swiss was obtained by breeding the Sahiwal cow with
 (a) Brown Swiss (b) Holstein - Friesian
 (c) Tharparkar (d) Ayrshire.
14. Which of the following is not a psychotropic drug?
 (a) Benzodiazepines (b) Barbiturates
 (c) LSD (d) Opium
15. In MOET (Multiple Ovulation Embryo Transfer Technology), the embryos can be recovered and transferred to surrogate mothers at
 (a) 4-16 celled stage (b) 8-32 celled stage
 (c) 2-4 celled stage (d) 6-32 celled stage.
16. Select the correct pair.
 (a) Mumps – Flavivirus
 (b) Measles – Coronavirus
 (c) Small pox – Variola virus
 (d) Influenza – Paramyxovirus
17. Match the columns I and II and select the correct option from the codes given below.
- | Column I
(Elements) | Column II
(Functions) |
|------------------------|------------------------------------|
| A. Molybdenum | (i) Opening and closing of stomata |
| B. Copper | (ii) Component of nitrogenase |
| C. Zinc | (iii) Component of plastocyanin |
| D. Potassium | (iv) IAA formation |
- (a) A-(ii), B-(i), C-(iii), D-(iv)
 (b) A-(ii), B-(iii), C-(iv), D-(i)
 (c) A-(iii), B-(ii), C-(iv), D-(i)
 (d) A-(iii), B-(i), C-(iv), D-(ii)
18. Which of the following human immunoglobulins can be transferred through placenta?
 (a) IgA only (b) IgE only
 (c) IgG only (d) IgM only
19. Read the given statements regarding malaria and select the incorrect statement.
 (a) Patients suffering from benign tertian malaria experiences fever at an interval of 48 hours.
 (b) Quartan malaria is caused by *Plasmodium malariae*.
 (c) The malarial parasite reproduces asexually in liver cells.
 (d) *Plasmodium ovale* causes malignant tertian malaria.
20. Which of the following statements regarding facilitated diffusion is incorrect?
 (a) Facilitated diffusion is very specific as it allows cell to select substances for uptake.
 (b) The diffusion of hydrophilic substances occurs along the concentration gradient without involving energy expenditure.
 (c) In antiport method of co-transport, both molecules cross the membrane in opposite direction.
 (d) When a molecule moves across a membrane independent of other molecule, it is called symport.
21. T-lymphocytes are produced in _____ and matures in _____.
 (a) bone marrow, thymus
 (b) thymus, bone marrow
 (c) bone marrow, lymph nodes
 (d) myeloid stem cells, bone marrow
22. Which of the following sets of diseases represent communicable diseases only?
 (a) Rabies, Chikungunya, Dengue, Viral hepatitis
 (b) Rabies, Chicken pox, Amoebiasis, Rheumatoid arthritis
 (c) Rabies, Chikungunya, Dengue, Amoebiasis, Cancer
 (d) Chikungunya, Common cold, Mumps, Rheumatic heart disease
23. Which of the following is not an immunosuppressive drug?
 (a) Corticosteroids (b) Azathioprine
 (c) Cyclophosphamide (d) Amphetamines
24. A cell is said to be turgid, when
 (a) D.P.D = 0 (b) T.P = 0
 (c) O.P = D.P.D (d) O.P = 0.
25. Which of the following statements are correct regarding AIDS?
 (i) AIDS was first noticed in USA in 1981.
 (ii) The causative agent of AIDS attacks cytotoxic T cells.
 (iii) Zidovudine was the first drug used against AIDS and still being used for the treatment of AIDS.
 (iv) AIDS can be transmitted through shaking hands, sharing towels and insect bites.
 (v) HIV was previously known as HCLV III.
 (a) (ii), (iv) and (v)
 (b) (i), (iii) and (v)
 (c) (i), (ii) and (v)
 (d) (i) only

What *2* it?

Grimpoteuthis
 (Dumbo Octopus)

Winner: Rajat Kanti Mondal (W.B), Rajendra Kumar,
 Shristi Bhagal, Hooghly (W.B), Priyanshu Kumar

SOLUTION
 SEPTEMBER 2019

26. Select the mismatched pair.
- Autograft - Grafting of one's own tissue to another part of the body.
 - Xenograft - Transplantation between animals of different species.
 - Allograft - Transplantation between individuals of same species with same genetic background.
 - Isograft - Transplantation from a twin brother or sister.
27. Cancer of melanocytes is
- lipomas
 - melanomas
 - leukemias
 - myomas.
28. Substances which are incapable of inducing antibody formation by themselves, but can induce antibody formation on combining with larger molecules are called ____.
- self antigens
 - haptens
 - non self antigens
 - complete antigens
29. Read the following reactions and select the incorrect statements regarding these reactions.
- $2\text{NH}_3 + 3\text{O}_2 \longrightarrow 2\text{NO}_2^- + 2\text{H}^+ + 2\text{H}_2\text{O} + \text{energy}$
 - $2\text{NO}_2^- + \text{O}_2 \longrightarrow 2\text{NO}_3^- + \text{energy}$
- Both these reactions are part of nitrification process.
 - Nitrosococcus* and *Aspergillus* are involved in reaction (i).
 - Reaction (ii) is carried out by *Nitrobacter*.
 - Most of the bacteria involved in these reactions are photoautotrophs.
30. Symbiotic nitrogen fixation requires cooperation of ____ genes of legume and *nod*, ____ and ____ gene clusters of bacteria.
- nod*, *nif* and *fix*
 - nif*, *nod* and *fix*
 - nif*, *fix* and *nod*
 - fix*, *nif* and *nod*
31. Ranikhet disease is associated with
- hens
 - fishes
 - pigs
 - cows.
32. Which of the following is not an edible marine fish?
- Pomfret
 - Salmon
 - Sardine
 - Mrigala
33. Drooping down of leaves and young shoots that occurs due to loss of turgidity during noon is termed as
- incipient wilting
 - permanent wilting
 - temporary wilting
 - guttation.

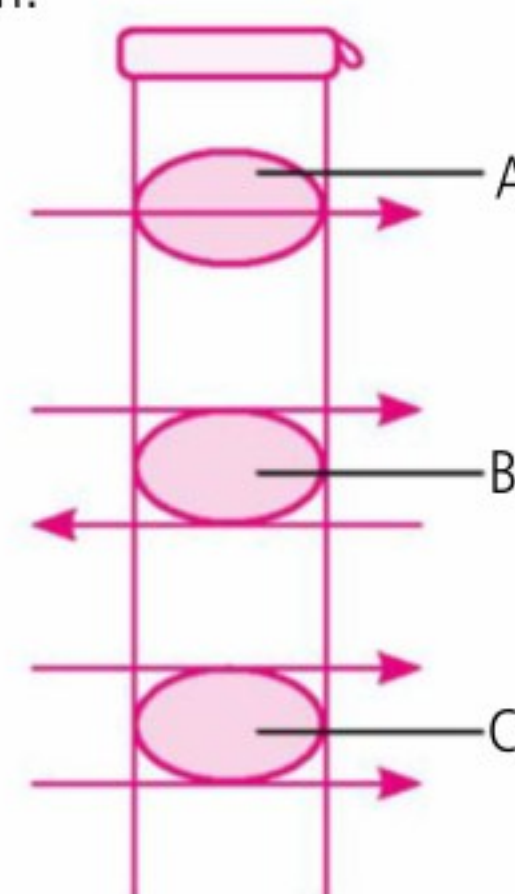
34. Read the given statements and select the correct option.

Statement A : Leghaemoglobin is a pinkish pigment which develops in the root nodules of leguminous plants when there is symbiotic association.

Statement B : Nodule formation is stimulated by cytokinin produced by cortical cells and auxin liberated by invading bacteria.

- Statement A is correct but statement B is incorrect.
- Statement A is incorrect but statement B is correct.
- Both statements A and B are correct.
- Both statement A and B are incorrect.

35. The given figure shows the transport of molecules. Select the correct option.



- A-Uniport, B-Symport, C-Antiport
- A-Uniport, B-Antiport, C-Symport
- A-Antiport, B-Symport, C-Uniport
- A-Symport, B-Antiport, C-Uniport

ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (c) | 2. (b) | 3. (d) | 4. (c) | 5. (b) |
| 6. (c) | 7. (b) | 8. (b) | 9. (a) | 10. (a) |
| 11. (b) | 12. (c) | 13. (a) | 14. (c) | 15. (b) |
| 16. (c) | 17. (b) | 18. (c) | 19. (d) | 20. (d) |
| 21. (a) | 22. (a) | 23. (d) | 24. (a) | 25. (b) |
| 26. (c) | 27. (b) | 28. (b) | 29. (d) | 30. (a) |
| 31. (a) | 32. (d) | 33. (c) | 34. (a) | 35. (b) |



UNSCRAMBLED WORDS

SEPTEMBER 2019

- | | |
|------------------|-------------------|
| 1-e- MANDIBLE | 2-d- TRANSFECTION |
| 3-f- PORPHYRIN | 4-g- VASODILATION |
| 5-h- THALASSEMIA | 6-b- BOLTING |
| 7-a- NULLISOMY | 8-c- HEPARIN |
| 9-j- DIADELPHOUS | 10-i- DIAPAUSE |

Winner : Rakesh Patial (Kangra, H.P.)

WORD GRID

Readers are requested to send their responses of word grid to be the winner.

Find and encircle the words in the given grid, running in one of the possible directions; horizontal, vertical or diagonal by reading the clues given below.

Clues

- The mid dorsal flap of earthworm's intestine which increases the surface area of the intestine for efficient secretion and absorption during digestion.
- A cluster of ribosomes which is connected with mRNA and play an important role in peptide formation.
- A stage of prophase in meiosis-I in which synapsis of homologous chromosomes takes place.
- The last geological period of the Paleozoic era during which origin of conifers occurred.
- A class of arthropods which includes animals such as scorpions, spiders, tick and mites, etc.
- The study of different aspects or appearance of plants in different seasons of a year.
- An attachment point in seed through which it is attached to the funicle.
- A collection of secretions from the male accessory glands and sperms from testes.
- A condition during which the body or a region of body is deprived of adequate oxygen supply at tissue level.
- A drug which is derived from opium and used in medicine for inducing sleep.
- A soluble carbohydrate found in the root tubers of *Dahlia*.
- A bone which lies just above the larynx and does not articulate with any other bone.
- A lymphocyte present in thymus.
- An ear ossicle which is attached to stirrup shaped bone of an ear, which in turn is attached to oval membrane covering the fenestra ovalis.
- The phenomenon of resemblance of one species with another, especially to escape predators.
- Third larva of the liver fluke, produced from sporocyst by parthenogenesis.
- A part of alimentary canal characterised by the presence of nodules of lymphatic tissue called Peyer's patches which produce lymphocytes.
- The phenomenon of alternation of generation in which one generation reproduces asexually followed by sexually reproducing generation.
- A chronic disease, caused by the bacterium *Mycobacterium leprae*, that affects the skin, mucous membranes and nerves.
- A terrestrial biome characterised by the mostly lack of trees and permanently frozen subsoil.

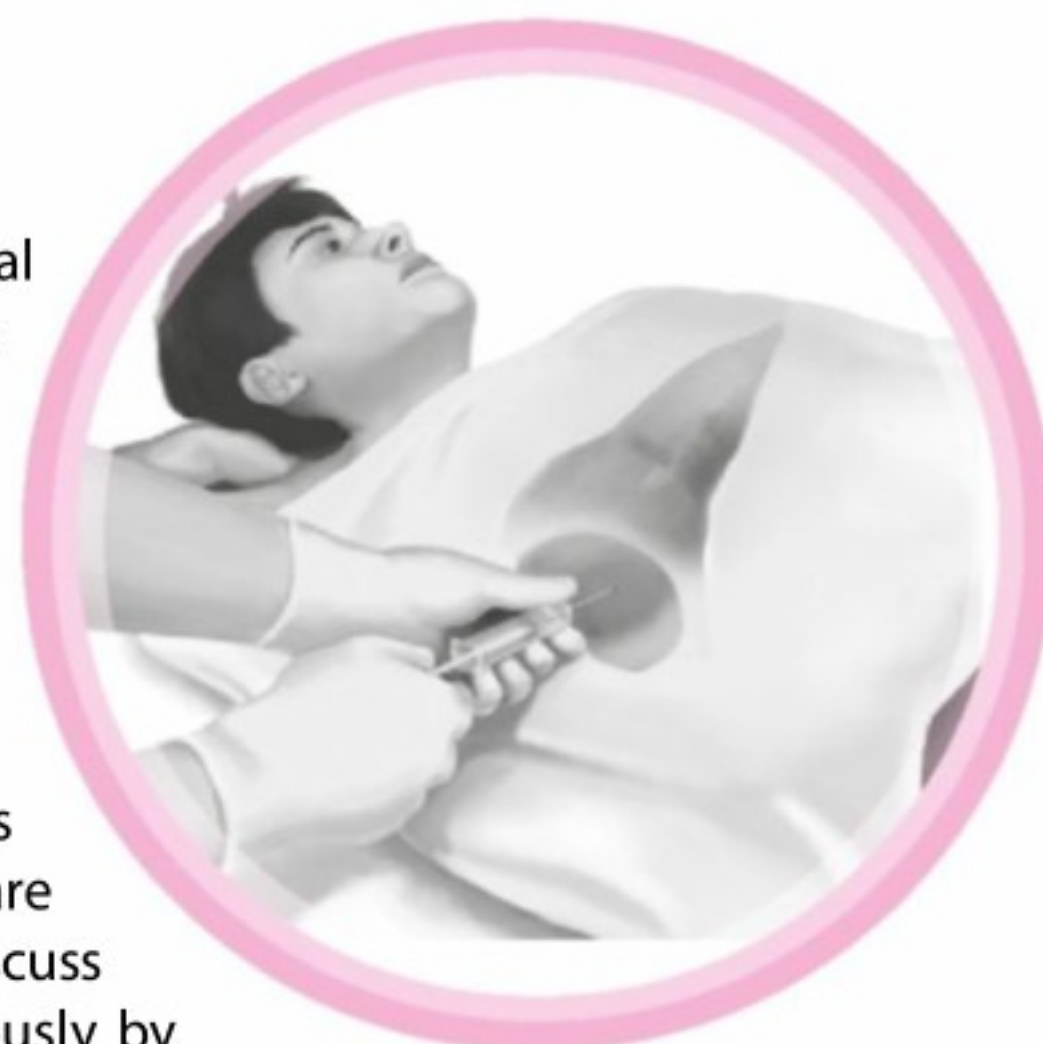


M	E	M	L	A	M	B	A	R	E	D	I	A	R	E
E	M	U	E	T	R	A	C	H	Y	P	O	X	I	A
T	P	C	P	T	Z	E	A	L	O	U	S	E	T	E
A	E	I	R	I	Y	A	R	A	C	H	N	I	D	A
G	C	N	O	L	G	P	O	L	Y	S	O	M	E	T
E	T	C	S	E	O	H	H	T	U	N	D	R	A	T
N	I	U	Y	U	T	E	I	L	S	C	I	O	N	H
E	N	S	E	M	E	N	R	L	O	U	D	D	Y	Y
S	I	N	U	S	N	O	E	H	U	S	H	P	A	M
I	N	N	F	I	E	L	Y	Y	P	M	O	O	M	O
S	I	R	U	S	T	O	N	O	R	X	P	L	B	C
O	W	L	R	L	R	G	A	I	I	E	I	E	E	Y
U	A	R	I	D	I	Y	I	D	C	R	A	P	E	T
P	E	R	M	I	A	N	D	Y	K	E	T	O	F	E
H	A	M	I	M	I	C	R	Y	U	L	E	T	O	N

*Please send entries of solutions both with words and scanned copy of the grid within 10th of every month..

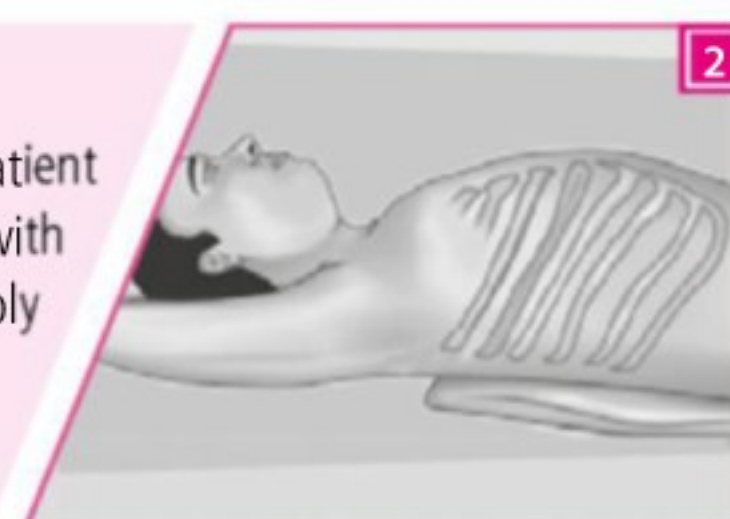
Biopsy

Biopsy is a medical procedure performed by a surgeon or an, interventional Radiologist in which a piece of tissue or sample of cells are removed from human body. The extracted sample cells or tissue is examined in a laboratory by pathologist to determine the presence or extent of a disease. Biopsy is usually recommended by medical practitioner when an initial test suggests that an area of tissue in the body is not normal. Biopsies are most often done to look for cancer, however, it also helps to identify various other ailments. Biopsy is the only sure way to diagnose most cancers. Imaging tests like CT scans and X-rays can help in identifying area of concerns, but they cannot differentiate between cancerous and non-cancerous cells. There are different kinds of biopsies. Some of them are needle biopsy, bone biopsy, liver biopsy, bone marrow biopsy, etc. Here, we will discuss percutaneous liver biopsy. Liver biopsies are typically performed percutaneously by inserting a needle through the skin under ultrasonic guidance. The liver can also be biopsied via a catheter inserted through the jugular vein to capture a tissue sample, or can be biopsied surgically.



1 Pre-procedural evaluation of potential biopsy patient is done, which includes review of patient's medication, blood tests, fasting, etc.

After the pre-procedural evaluation, patient is positioned supine, (lying horizontally with face up), with the right hand comfortably resting behind the head.



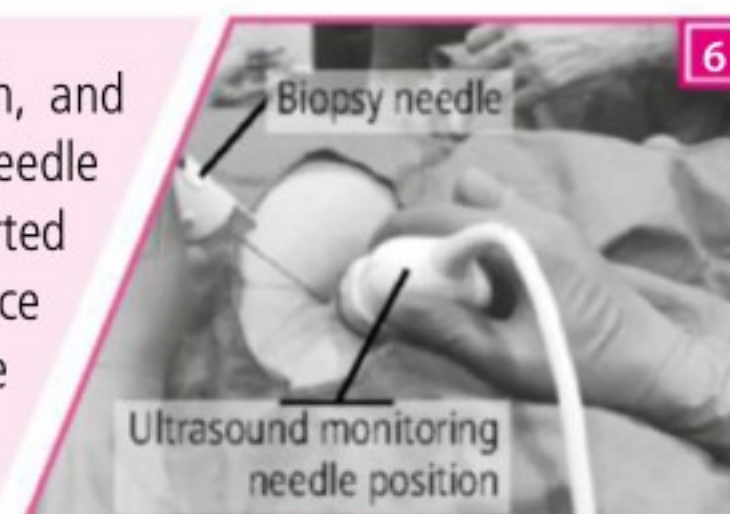
3 The local area of skin where the biopsy is to be performed is wiped with an alcohol swab to insure sterile conditions.

After the skin is cleansed and draped, either the surgeon taps on the abdomen to locate the liver or uses imaging techniques such as ultrasound or CT scan to identify the location of the liver mass.



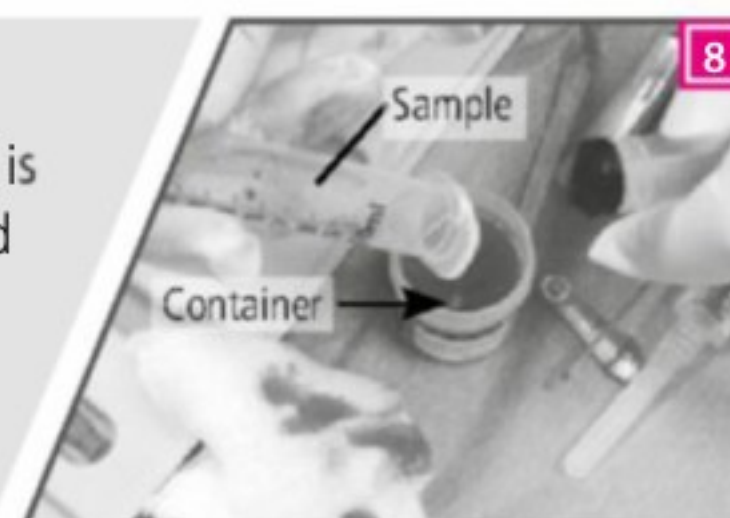
5 The local anaesthesia is infiltrated under the skin abdominal/intercostal space to the liver capsule.

Patient is instructed to hold his/her breath, and under the ultrasound guidance, a thin needle (cutting needle or a suction needle) is inserted through abdomen into the liver and small piece of tissue is removed. Throughout the course of biopsy the needle position is monitored.



7 Sterile bandage is applied over the biopsied area and a post - procedure scan is performed to evaluate for any immediate post - biopsy bleed and the pulse and blood pressure are monitored.

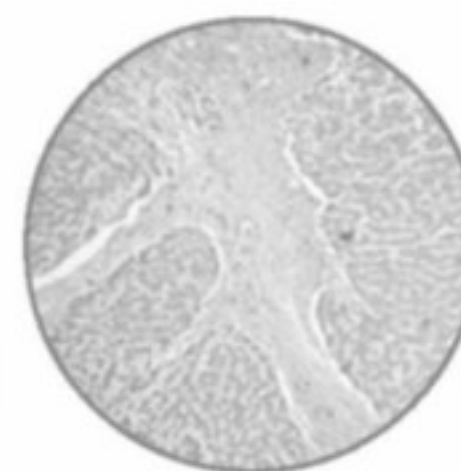
After the biopsy needle is deployed, the specimen is placed within a sterile container filled with formalin.



The liver tissue sample is sent to the lab for testing. The tissue is examined under a microscope to determine the damage to the liver and to confirm the diagnosis.



Liver biopsy showed inflammation in the periportal area with fibrosis.





The questionnaire contains multiple choice questions based on current affairs and recent developments worldwide. Various facts are presented in question form to enable the students to develop knowledge as well as to test their general awareness skills and equip them with all essentials to crack various PMTs (AIIMS, et(c)). This will also help them to excel in other competitive exams like Banking and various Government recruitment exams.

1. Which three banks will merge into a single unit to form the 2nd largest bank of India?
 - (a) PNB, OBC and United Bank of India
 - (b) Indian Bank, OBC and Indian Overseas Bank
 - (c) Allahabad Bank, Indian Bank and PNB
 - (d) PNB, Syndicate Bank and Bank of India
2. Which country recently requested the United Nations to call back all peacekeepers from the country by June 2020?
 - (a) Algeria
 - (b) Sudan
 - (c) Germany
 - (d) Bahrain
3. Which country has launched its own Space Command?
 - (a) India
 - (b) United States
 - (c) China
 - (d) Russia
4. What is the theme for International Day of peace 2019?
 - (a) Together for Peace: Respect, Safety and Dignity for all
 - (b) The Right to Peace
 - (c) Climate Action for Peace
 - (d) Partnerships for Peace – Dignity for All
5. Who becomes the first person to declare as fugitive economic offender under the new Fugitive Economic Offenders Act?
 - (a) Vijay Mallya
 - (b) Nirav Modi
 - (c) Mehul Choksi
 - (d) Lalit Modi
6. Which movie won the Best Motion Pictures-Drama in the 2019 Golden Globes?
 - (a) Black Panther
 - (b) Bohemian Rhapsody
 - (c) A star Is Born
 - (d) BlackKkKlansman
7. Who became fastest Indian cricketer to reach 100 wickets in one-day internationals?
 - (a) Bhuvneshwar Kumar
 - (b) Mohammad Shami
 - (c) Jasprit Bumrah
 - (d) Yuzvendra Chahal
8. Which city included Hindi as the third official language to be used in its court?
 - (a) Dubai
 - (b) Bangkok
 - (c) Abu Dhabi
 - (d) Kuala Lumpur
9. Which country has sent World's first privately funded mission to moon?
 - (a) United States
 - (b) Israel
 - (c) Russia
 - (d) Germany
10. The fourteenth meeting of the conference of parties to the UN convention to Combat Desertification was held at
 - (a) India
 - (b) Sri Lanka
 - (c) Pakistan
 - (d) Nepal.
11. India has proposed to undertake deep ocean mining under which of the following projects?
 - (a) Samudrayaan
 - (b) Samudravaahan
 - (c) Samudravahak
 - (d) Samudravimaan
12. Who became the first-ever Indian tennis player to win a set in US open against Roger Federer?
 - (a) Rohan Bopanna
 - (b) Yuki Bhambri
 - (c) Sumit Nagal
 - (d) Somdev Devvarman
13. Which country has rejected the \$22 million G7 aid to fight Amazon rainforest fire?
 - (a) Brazil
 - (b) Peru
 - (c) Ecuador
 - (d) Argentina
14. The book "We are Displaced" is authored by
 - (a) Sharad Dutt
 - (b) Malala Yousafzai
 - (c) Saba Naqvi
 - (d) Sonia Singh.
15. What is the theme chosen for plastic waste management in 2019?
 - (a) Swachh Bharat
 - (b) Swachhta hi Sewa
 - (c) Swachhta ki Shakti
 - (d) Swachh Vatavaran
16. The Supreme Court has referred the Article 370 petitions for hearing to a special constitution bench. The bench will comprise how many members?
 - (a) Five
 - (b) Six
 - (c) Seven
 - (d) Eight
17. What is the name of the India's longest suspension bridge built in Leh by Indian Army?
 - (a) Maitri bridge
 - (b) Bogibeel bridge
 - (c) Koilwar bridge
 - (d) Ram jhula
18. Who was the first woman to reach the summit of Mount Everest, and the first woman to ascend all seven summits by climbing the highest peak on every continent?

- (a) Santosh Yadav (b) Junko Tabei
(c) Chhurim Sherpa (d) Arunima Sinha
19. Which stadium will soon be renamed as Arun Jaitley stadium?
(a) Rajiv Gandhi International Cricket Stadium
(b) Wankhede Stadium
(c) Feroz Shah Kotla Stadium
(d) Vidarbha Cricket Association Stadium
20. How soon should the elections to be held in the state after the end of the emergency?
(a) 3 months (b) 4 months
(c) 6 months (d) 9 months
21. Think tank of Government of India that replaced the Planning commission is
(a) NITI Aayog (b) NITI Raksha
(c) NITI Seva (d) NITI Shasan.
22. Which movie has become the first Bollywood film to go plastic-free?
(a) Coolie No. 1 (b) Mission Mangal
(c) Saaho (d) War
23. Which country's president passed away on September 6, 2019?
(a) Zimbabwe (b) United States
(c) Canada (d) Brazil
24. Who has become the first IPS officer to be conferred with the Tenzing Norgay National Adventure Award 2018?
(a) IPS Aparna Kumar (b) IPS Yamuna Prasad
(c) IPS Somen Burma (d) IPS Sujata Singh
25. Which union ministry has launched the National Lab Directory (NLD)?
(a) Ministry of Consumer Affairs, Food and Public Distribution
(b) Ministry of Corporate Affairs
(c) Ministry of Finance
(d) Ministry of Commerce and Industry
26. The Government e Marketplace (GeM) has signed a MoU with which organisation to enable growth of MSMEs, Start-ups and Women Entrepreneurs?
(a) SIDBI (b) SEBI
(c) IRDA (d) NHB
27. Vikram Lander successfully separated from Chandrayaan-2 orbiter on which date?
(a) 2nd September 2019 (b) 3rd September 2019
(c) 4th September 2019 (d) 5th September 2019
28. Which state government has decided to offer modern nursery education at anganwadis?
(a) Andhra Pradesh (b) Uttar Pradesh
(c) Madhya Pradesh (d) Arunachal Pradesh
29. 'Shagun' portal is associated to which field?

- (a) School Education (b) Women Empowerment
(c) Music (d) Sound Pollution

30. Which among the following Fundamental rights has been most disputable?
(a) Right to freedom of religion
(b) Right to freedom of speech
(c) Right to property
(d) Right to cultural and educational rights

ANSWER KEY

1. (a) 2. (b) 3. (b) 4. (c) 5. (a)
6. (b) 7. (b) 8. (c) 9. (b) 10. (a)
11. (a) 12. (c) 13. (a) 14. (b) 15. (b)
16. (a) 17. (a) 18. (b) 19. (c) 20. (c)
21. (a) 22. (a) 23. (a) 24. (a) 25. (a)
26. (a) 27. (a) 28. (c) 29. (a) 30. (c)



Contributed by: Jenifer Rajak, (W.B.), Sameekshya Kar, (Odisha), Prithwiraj Das

SOLUTIONS TO September 2019 WORD GRID

C	C	H	E	R	B	A	R	I	U	M	U	L	E	S
O	A	O	D	C	O	R	E	N	R	Y	H	Y	N	A
R	R	L	E	S	A	P	N	T	E	C	A	L	Y	X
K	O	D	M	L	X	L	A	E	M	O	E	N	D	S
M	T	F	A	T	O	U	L	G	I	P	M	A	E	S
Z	E	A	T	I	N	M	C	U	A	L	A	C	S	O
N	N	S	U	R	E	U	A	M	S	A	T	R	I	A
O	E	T	E	A	M	L	L	E	N	S	O	O	C	B
T	T	O	R	T	E	E	C	N	O	M	L	M	C	U
O	O	B	E	E	A	N	U	T	R	A	O	E	A	L
C	A	P	C	T	T	E	L	S	K	O	G	G	T	B
H	D	E	O	R	E	N	I	N	B	U	Y	A	I	I
O	M	A	N	A	O	G	O	B	L	E	T	L	O	L
R	A	P	I	D	P	Z	Y	M	A	S	E	Y	N	S
D	A	F	A	D	I	C	A	L	C	A	U	L	I	N

- | | |
|---------------|-----------------|
| 1. Herbarium | 11. Goblet |
| 2. Mycoplasma | 12. Bulbils |
| 3. Holdfast | 13. Recon |
| 4. Coelom | 14. Zymase |
| 5. Setae | 15. Notochord |
| 6. Axoneme | 16. Callus |
| 7. Sap | 17. Haematology |
| 8. Zeatin | 18. Atria |
| 9. Tetrad | 19. Acromegaly |
| 10. Carotene | 20. Integuments |

SCIENTIST EXPRESS

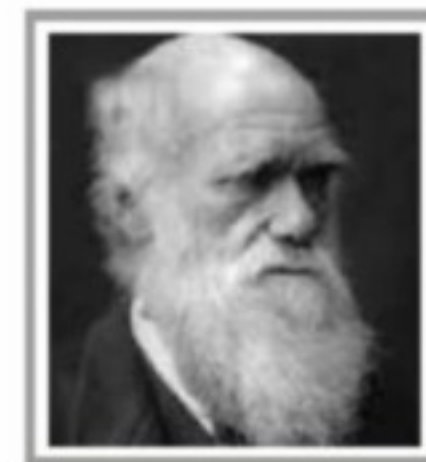
Contributions of Scientists in the Field of Evolution



Jean-Baptiste Lamarck, (1744 – 1829) was a pioneer French biologist who is best known for his idea that acquired characters are inheritable, an idea of Lamarckism. Lamarck stands out in the history of biology as the first writer to set forth - both systematically and in detail comprehensive theory of organic evolution that accounted for the successive production of all the different forms of life on Earth. He wrote a book in 1801 entitled "Theory of Inheritance of Acquired Characteristics", where he said an organism could pass on the traits that it has acquired through use or disuse during its lifetime to its offspring. In 1809 he published a book, "Philosophie Zoologique", in which he described a two part

mechanism by which change was gradually introduced into the species and passed down through generations. Later on, idea of lamarckism became obsolete.

Charles Darwin, (1809 – 1882) English naturalist Darwin is best known for his work on the theory of evolution, which he detailed in his book, "On the Origin of Species." The book, published in 1859, stated that all life on Earth descended over time from common ancestors, and a process of natural selection governs the branching pattern of biological changes. Major accomplishments of Darwin include his voyage on ship-named H.M.S Beagle. During voyage he solved the mystery of the formation of coral reefs and atolls, independently conceived the theory of natural selection in 1838 and discovered this theory along with Alfred Wallace.



Hugo De Vries, (1848-1935) was a Dutch botanist and geneticist who introduced the experimental study of organic evolution. His theory of biological mutation, though considerably different from a modern understanding of the phenomenon, resolved ambiguous concepts concerning the nature of variation of species at that time. He came to the idea of "sudden" inheritable changes while working on *Oenothera lamarckiana* (evening primrose) plants. De Vries was a strong proponent of the idea of discontinuous variations. He believed species evolve from other species through sudden, large changes of character or traits which is popularly known as "mutation theory".

J.B.S Haldane, (1892 - 1964) was a British geneticist and evolutionary biologist. His most important contribution to science was the mathematical theory of evolution which combined the evolutionary process defined by Darwin and the science of genetics founded by Mendel. Haldane introduced the modern concept of abiogenesis in an eight-page article titled "The origin of life", in the Rationalist Annual in 1929, describing the primitive ocean as a "vast chemical laboratory" containing a mixture of inorganic compounds – like a "hot dilute soup" in which organic compounds could have formed. He also developed the mathematical theory of population genetics, along with Ronald Fisher and Sewall Wright.



Stanley Miller, (1930 – 2007) was an American chemist who made landmark experiments in the origin of life by demonstrating that a wide range of vital organic compounds can be synthesised by fairly simple chemical processes from inorganic substances. He has been described as the "father of prebiotic chemistry". Miller became a member of the National Academy of Sciences in 1973 and in 1983 was awarded the Oparin Medal by the International Society for the study of the Origin of Life.

Please send your feedback for our new article by mail at editor@mtg.in

Readers' CAFE



Dear Readers,

We have been receiving a lot of queries from students and their parents, so we decided to ease you out by introducing a new column to guide you through your worries, concerns and questions related to your studies and beyond. Readers can send their queries (concerns beyond specific subjects, career guidance, tips for better performance, etc.) by post or by email at editor@mtg.in. The solutions to your queries given by MTG experts will definitely ease your anxiety and provide you a clear vision and a right direction to achieve your goals. Best and most relevant questions will be chosen and published with the sender's name.

► What is the best way to study NCERT biology to have all the information available at my fingertips?

Astha Jain, (Shimla)

Dear Astha, it's always good to hear from our readers. Biology is not a subject to be memorised or crammed. It is a conceptual subject and needs to be understood and learned. Here, are few tips which will help you to have NCERT biology at your fingertips.

- To study NCERT biology you must ascertain first, the important topics from the entire book and segregate them into sub-sections (Botany & Zoology).
- Read the entire chapter once and then analyse the difficulty level of topics, if any topic seems to be difficult, make notes and try to revise it daily.
- Try to make flow charts for the difficult topics and keep revising it.
- Revise each and every chapter. Make a daily habit to revise at least two chapters before sleeping. Remember practice is the key to perfection.
- Draw and label diagrams as sketching of diagram of a biological process can help you to learn the concept in a simpler way. After reading the topic, draw the process and label it properly.
- Create mnemonic device as it can be very helpful while studying topics which needs to be remembered in an orderly fashion. For example, order of the substrates in the Krebs' cycle.
- Break down the complex words into their roots as you might find the vocabulary of biology complicated. Understanding the meaning of complex words may help you to grasp it smoothly.
- Solve all the examples provided in NCERT textbooks.
- Always use markers to highlight important points in your notebooks/books.

► How do I study biology for the CBSE class 12 board exam?

Tanuja Bisht, (Lucknow)

Dear Tanuja, As we all know Biology paper weightage consists of 70 marks for theory and 30 marks of practical paper. So, in order to gain good marks, you have to score well in both.

- First of all, you should start your preparation from the very first day of the class. Start preparing your neat and clean notes supplemented with properly labelled diagrams, flow charts wherever you think they are appropriate.
- Keep on revising the syllabus again and again revising same thing will help as to engrave it into your mind in such a way that you will not forget them easily and for every next round of revision you will require lesser and lesser time.
- Do not cram the things because the things that we understand, visualise and conceptualise remain in our mind for long as compared to crammed things.
- After learning, always try to solve the practice papers of last 5 years. Try to solve as many questions as possible. This will help you to evaluate yourself and you would come to know about your weak points. Then re-work on the same lacking. One more important thing if you are forgetting few things again and again like any facts or any scientific names of disease, etc., just try to prepare a brief clue chart of this and paste it on the wall in front of you in such a way that after every single moment your eyes will fall on that chart, flash card, etc. So, in this way you can memorise such things.
- One common mistake that students usually do that we are perfect in this subject so we should leave this side and focus on other but our human mind plays a game; it will remember only those things which we usually visualise again and again. So, keep on revising even if you are perfect in that subject. This will finally speed up your learning time.
- Try to follow these steps and it will surely help to score good marks in Class 12 board exam. Hope, it was helpful to you.

► Kindly suggest few books of MTG publications which can be helpful for CBSE Class 12 Biology students.

Uzma Shoukat (Kolkata)

Dear Uzma, hey! I will strongly recommend first do the NCERT, then you can refer MTG NCERT at your Fingertips Biology. It is based on NCERT syllabus. It has concrete and systematic explanation of each topic in easy manner. It also has a lot of questions for practice following the order of increasing difficulty. It has different section questions for each type like MCQ, Higher Order Thinking, NCERT Exemplar with hints and explanations. Then you can also refer MTG Question Bank -21 Sample papers Biology and MTG CBSE Champion (XII) Biology which contains past year papers with solutions provided by subject experts.

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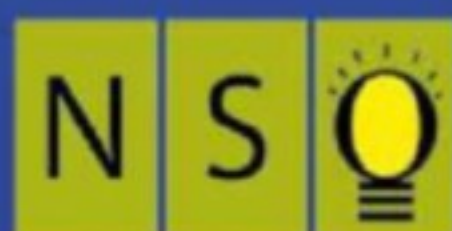
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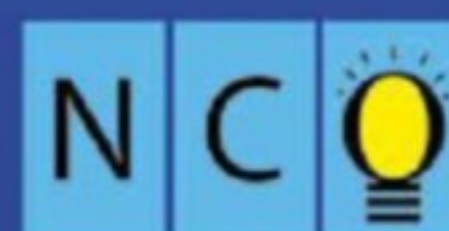
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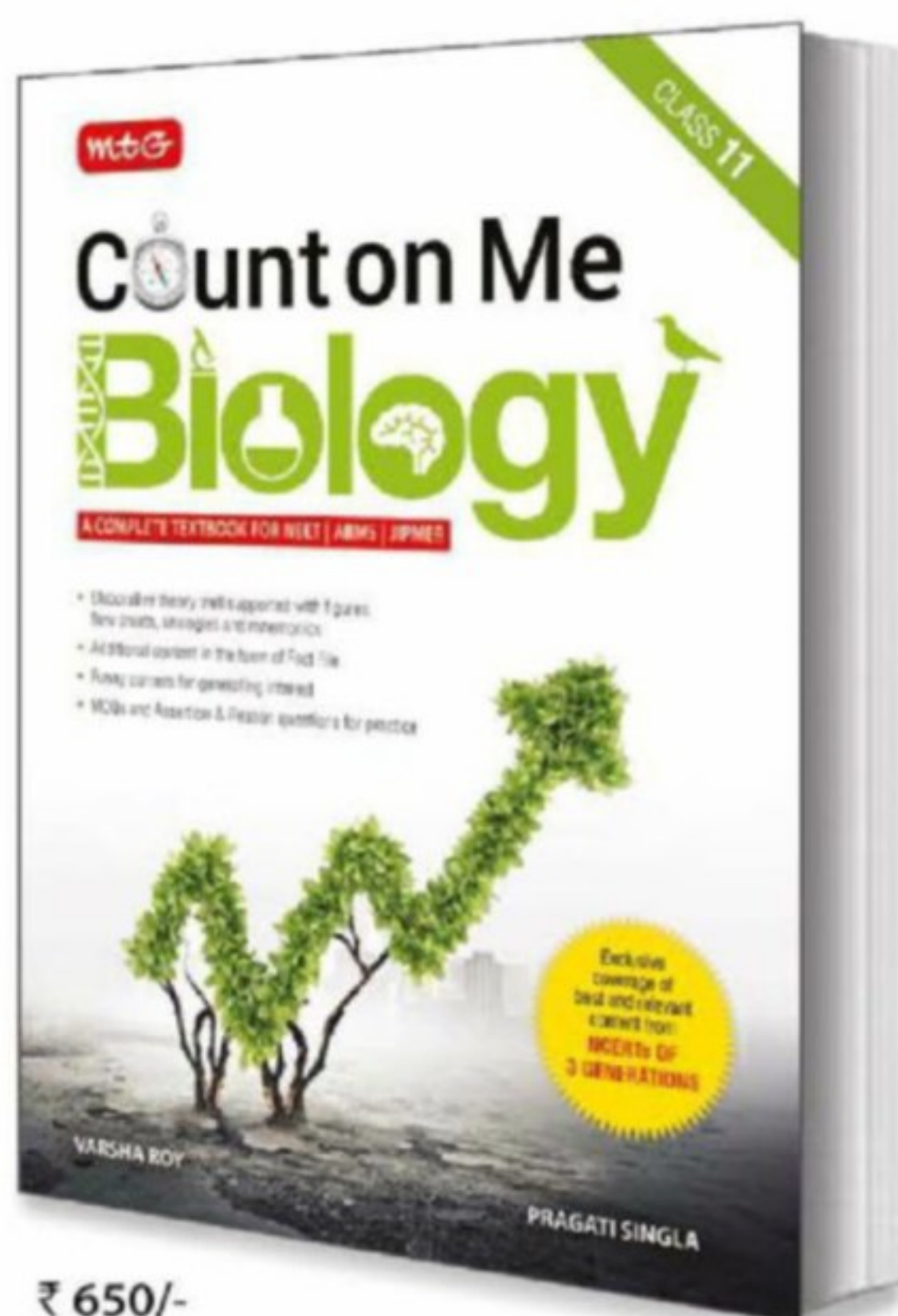
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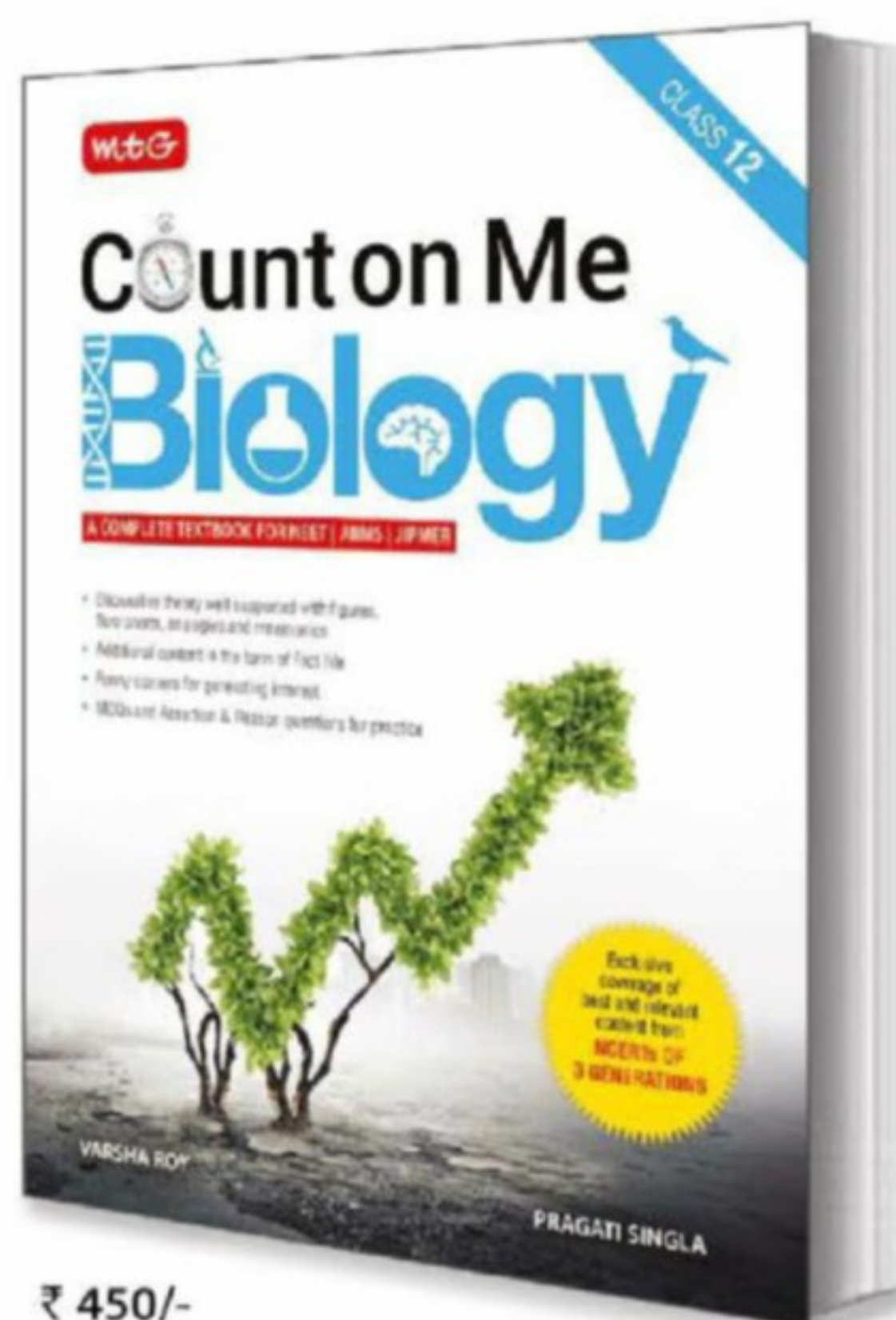
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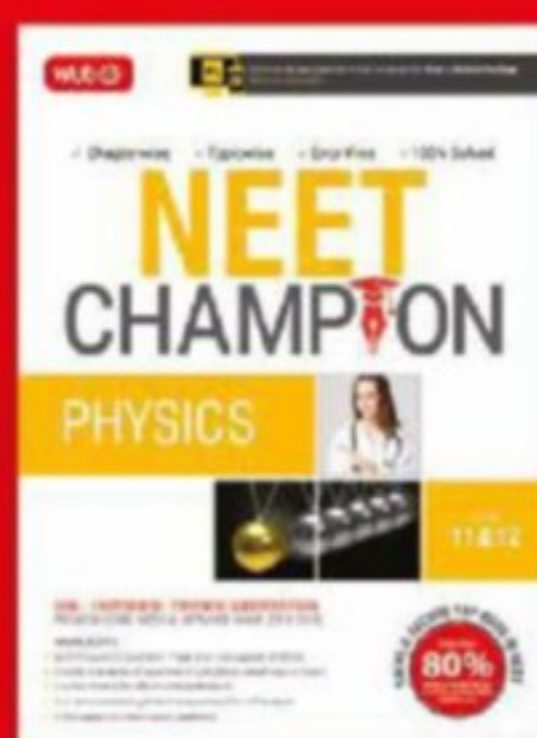


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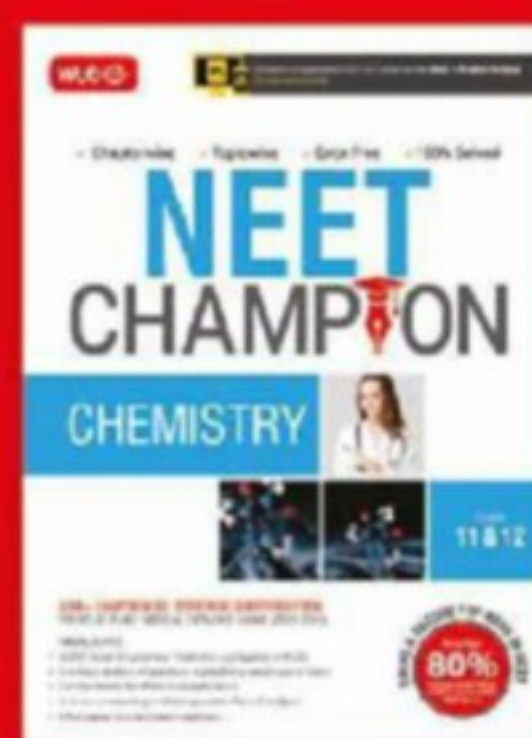
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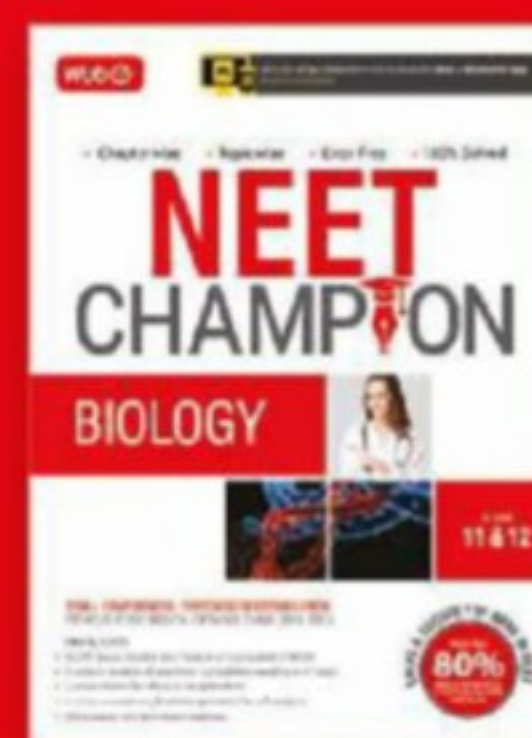
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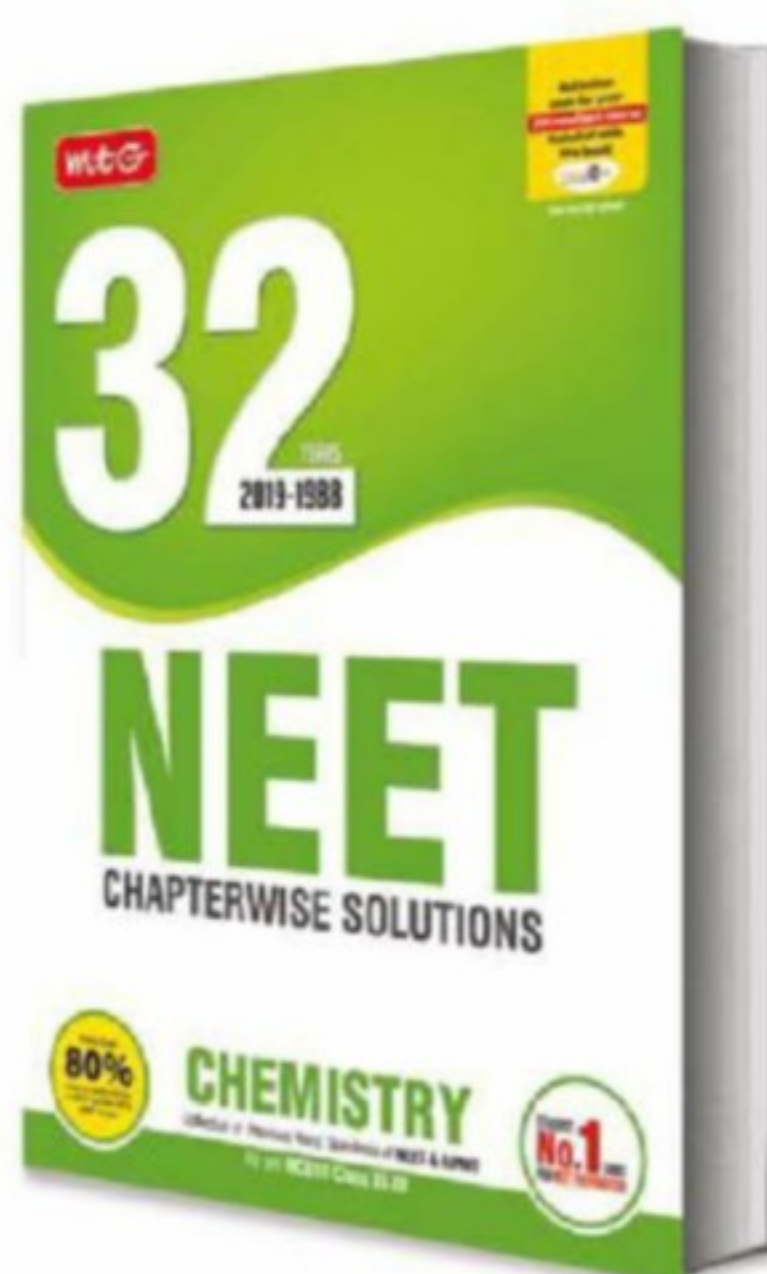
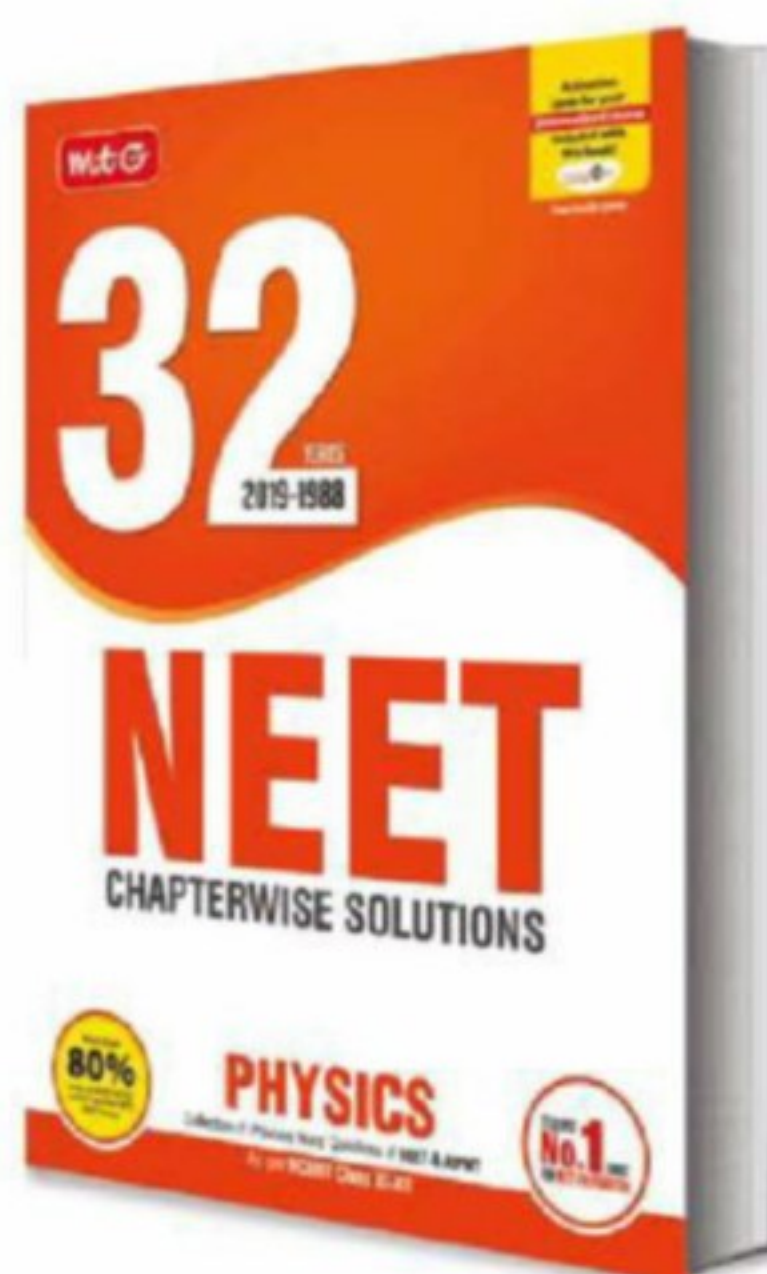


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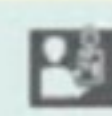
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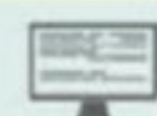
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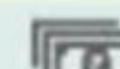
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